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SCIENCE

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CONTENTS

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THE CHICAGO MEETING

THE seventy-third meeting of the American Association for the Advancement of Science, held in Chicago from December 27 to January 1, was the second of the greater convocation week meetings of the association and of the national scientific societies associated with it, convened once in four years successively in New York, Chicago and Washington. The remarkable scientific activity of the central west and of the reconstruction period following the war were adequately reflected by the attendance and programs at Chicago, which have probably not been surpassed by any previous gathering of scientific men in this or any other country. In addition to fourteen sections of the association, forty-one national scientific societies met in Chicago and the official program of 112 pages exhibited the scientific productivity of the nation in the whole range of the natural and exact sciences.

The association has been fortunate in its presidents. The address of the retiring president, Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, on "Twenty-five years of bacteriology," printed in the last issue of SCIENCE, was an admirably clear presentation of a subject unsurpassed in its importance to human welfare, described by one who has led in the work. Dr. L. O. Howard, chief of the Bureau of Entomology, presided with dignity, skill and tact. He has played a large part in a subject in which science has demonstrated its service in the economic development of the nation and has been the chief executive officer of the association during the twenty-two years which have witnessed such an extraordinary development of the scientific work of the country, paralleled by the growth of the association from some 1,200 to over 10,000 members.

Professor E. H. Moore, of the University of Chicago, who will preside at Toronto and give his address at Boston is the acknowledged leader of American mathematicians. It is now many years since that science which is fundamental to all others has supplied a president to the association, and it is fortunate that a representative could be selected with the unanimous approval of all mathematicians.

Dr. D. T. MacDougal, director of the department of Botanical Research of the Carnegie Institution, who has been active in the organization of the work of the association, more specially in the Pacific and Southwestern Division, was elected general secretary to succeed Professor E. L. Nichols, of Cornell University. By the constitution the general secretary is entrusted with the important task of promoting the organization of the association especially in its relation to the affiliated societies. Another step that will promote the efficiency of the work of the association was the authorization of the appointment of an assistant secretary who will assist the permanent secretary in the scientific work of the association, as he is now assisted in the work of the office by the efficient executive assistant, Mr. Sam Woodley.

The sessions were held mainly in buildings of the University of Chicago, which furnished excellent facilities. The University Baptist Church provided for the sessions of Section K, Political and Economic Sciences, and the Quadrangle Club (Faculty Club) was also made available for some meetings, dinners, etc. At the Chicago Art Institute was held the reception of the Wild Flower Preservation Society, at which was exhibited a collection of flower portraits, etc. The exhibit of working models on wireless telephony, set up through the cooperation of the National Research Council, was also in the Art Institute.

The local arrangements for the meeting were in charge of the local committee:

J. Paul Goode, General Chairman
Gilbert A. Bliss, Publicity
Henry C. Cowles, Membership
Henry G. Gale, Meeting places
Frank R. Lillie, Finance
William D. McMillan, Hotel Accommodations

To the efficient and tireless efforts of Professor Goode and the other members of the local committee is due, in very great measure, the success of the Chicago meeting.

The arrangement by which admission to the three general sessions was by ticket perhaps caused a small amount of unavoidable difficulty, but it made possible an analysis of the attendance. This rule is in exact accord with the provisions of the by-laws. Tickets were given out only to registered persons, this applying to guests as well as to members.

The total registration for the Chicago meeting was 2,412. This is the largest registration ever recorded for the association, but it must be remembered that many persons in attendance at the meeting failed to register, so that the corrected number was much larger. Of those registering 1,383 were members of the association or delegates from institutions, 377 were members of associated societies not members of the association, 237 were invited guests, students of the University of Chicago, and 415 were other guests.

The geographical distribution of the attendance is shown below:

United States	Total	United States	Total
Alabama	4	North Carolina	7
Arkansas	5	Oregon	3
Arizona	7	Oklahoma	15
California	27	Ohio	121
Colorado	22	Pennsylvania	57
Connecticut	21	Rhode Island	5
Delaware	1	South Dakota	8
Dist. of Columbia.	81	South Carolina	3
Florida	4	Tennessee	19
Georgia	6	Texas	16
Idaho	1	Utah	1
Illinois	856	Virginia	8
Indiana	98	West Virginia	11
Iowa	90	Vermont	2
Kansas	63	Wyoming	4
Kentucky	17	Washington	5
Louisiana	5	Wisconsin	181
Maine	0	**Other Countries**	**Total**
Massachusetts	50	Philippines	10
Maryland	15	Australia	1
Missouri	70	Argentina	1

Mississippi	10	Porto Rico	1
Michigan	125	India	1
Minnesota	72	Switzerland	1
Montana	5	France	1
Nebraska	29	Japan	1
New Hampshire	9	China	20
New Jersey	16	Germany	1
New Mexico	2	Canada	48
Nevada	0	England	2
New York	132	Czecho-Slovakia	1
North Dakota	12	Grand Total	2,412

Two general evening sessions of popular interest, were held. At one of these was given an illustrated lecture by Dr. R. F. Griggs, on the region of Mt. Katmai, Alaska, and the "Valley of Ten Thousand Smokes." The other general interest lecture was by Professor R. W. Wood, on high power fluorescence and phosphorescence, in connection with which he performed numerous very ingenious experiments and demonstrations dealing with the study of these phenomena and of ultra-violet light.

The opening session, Monday evening, and the two general interest sessions were held in Mandel Hall. Attendance on these three evenings was as follows:

	Members of A. A. A. S. and Delegates	Guests, Members of Associated Societies Not Members of A. A. A. S.	Guests, University Students	Special Guests Not in Other Groups	Total Attendance
Opening session, Monday evening, opening addresses and address of retiring president, Dr. Simon Flexner	401	94	76	142	713
Second general session, Lecture by Dr. Robert F. Griggs	279	78	86	76	519
Third general session, Lecture by Dr. Robert W. Wood	380	101	76	153	710

Several new or unusual features characterized this meeting. The visible directory of those registering, kept currently corrected by several typists and attendants, proved very valuable. The panels bearing the directory slips were hung along one side of the registration room, the north room on the first floor of Reynolds Club.

The increase of scientific knowledge and interest among the general public is one of the most important functions of the association and the one which it has been most difficult to accomplish. The reports in the press vary from year to year, and at Chicago represented a fair average. Several of the more important papers, such as that of Professor Michelson on the application of interference methods to astronomical measurements, were fully report, not only in Chicago but also in New York and other cities. The Science Service definitely organized at Chicago for the wide-spread diffusion of current scientific information will hereafter make possible adequate reports of scientific meetings.

The minutes of the proceedings of the Council, and reports of sections and affiliated societies will be printed in later issues of SCIENCE. Among the matters of general interest transacted at the meetings of the Council are the following:

It was decided that the next meeting of the American Association will be at Toronto, on Tuesday, December 27 to Saturday, December 31, 1921, inclusive. The opening session will be on Tuesday evening. The meeting for 1922–1923 will be held in Boston, and that for 1923–24 will be held in Cincinnati. Then will follow the stated convocation meeting in Washington.

Dr. Burton E. Livingston was reelected permanent secretary and Dr. R. S. Woodward was reelected treasurer, each for a term of four years. Dr. L. O. Howard and Professor Herbert Osborn were elected members of the executive committee.

The Academies of Science of Michigan and of Oklahoma were affiliated with the association.

The collection of portraits and autograph letters of all presidents of the association made by Dr. Marcus Benjamin of the Smithsonian Institution will be purchased under conditions representing a partial gift to the association.

The sum of $5,000 was appropriated for

the Grants Committee to distribute during the year 1921.

On the Jane M. Smith fund the following were appointed with power to act during 1921: L. O. Howard, W. J. Humphreys and B. E. Livingston.

Among the resolutions adopted by the Council are the following:

Be it resolved: That the American Association for the Advancement of Science would welcome the organization of Mexican men of science, and their affiliation with this Association.

Resolved: That a committee of seven be appointed to cooperate with such organization as Mexican men of science may form.

The following were appointed on this committee: L. O. Howard, *Chairman,* A. E. Douglas, E. L. Hewitt, D. S. Hill, W. J. Humphreys, D. T. MacDougal and W. Lindgren.

Whereas the American Association for the Advancement of Science includes sections on Physiology, Experimental Medicine and Zoology, and

Whereas advancement of knowledge in these sciences, which is dependent upon intensive study of living tissue, is inevitably followed not only by amelioration of human suffering, but also by a lessening of animal disease and by substantial economic gain and by conservation of the food supply, and

Whereas this association is convinced that the rights of animals are adequately safeguarded by existing laws, by the general character of the institutions which authorize animal experimentation and by the general character of the individuals engaged therein,

Therefore be it resolved, that this association agrees fully with the fundamental aim of those whose efforts are devoted to the safeguarding of the rights of animals but deprecates unwise attempts to limit or prevent the conduct of animal experimentation such as have recently been defeated in California and Oregon, for the reason that such efforts retard advance in methods of prevention, control and treatment of disease and injury of both man and animals and threaten serious economic loss, and be it further

Resolved, that a copy of these resolutions be included in the official records of this Association, and that copies be sent to the national congress, to the legislatures of each state in the union and to each member of the Association.

Whereas, clean culture of roadsides and the drainage of marshes in the United States is imperiling the existence of the wild-life of our country not now included in special preserves, and

Whereas, the preservation of this wild-life not in preserves is felt to be of great national importance not only to students and lovers of nature, but to human welfare in general, therefore,

Be it resolved, by the council of the American Association for the Advancement of Science, that it appreciates the importance of preserving this wild-life not in preserves, and that it lends its moral support to the effort to combine all interested organizations in a cooperative investigation and conservation program for the preservation of our unprotected wild-life.

Whereas, in recognition of the unique character and value of our National Parks and Monuments to present and future generations, twenty-four successive Congresses have wisely resisted attempts to commercialize them and have preserved them inviolate for nearly half a century,

Whereas, certain private interests are now seeking to secure special privileges in these areas, which if granted will seriously interfere with their true purpose and undoubtedly result in the entire commercialization of these unique national museums,

Therefore, be it resolved, that the American Association for the Advancement of Science request members of Congress first to amend the Water Power Act so that it shall not apply to National Parks and Monuments and that their full control be restored to Congress, and second, to reject all present and future measures which propose to surrender any part of these National Parks and Monuments to private control or to divert them in any way from their original and exclusive purpose, the preservation for all future generations of unique representations of natural conditions such as exist in no other part of the world.

SOME ECONOMIC PHASES OF BOTANY[1]

It is an old custom for the retiring vice-president of this section to deliver an address.

[1] Address of the vice-president and chairman of Section G, botany, American Association for the Advancement of Science, Chicago, 1920.

These addresses have taken various forms; in some cases a review of the achievements in some particular phase of botany; others have looked to the future. It has been my pleasure to have heard many of the addresses on these annual occasions for thirty years, and I feel sure that they have epitomized the botany for the time. As I look back I find there was much of inspiration in these addresses. We regret that some of the men who sounded the keynote at these gatherings are no longer with us. It is interesting to look back to see what was uppermost in the minds of the speakers on these different occasions: N. L. Britton, "Botanical Gardens"; J. C. Arthur, "Development of Vegetable Physiology"; L. M. Underwood, "The Evolution of the Hepaticæ"; T. H. Macbride, "The Alamagordo Desert"; D. H. Campbell, "The Origin of Terrestrial Plants"; H. C. Cowles, "Economic Trend of Botany"; B. T. Galloway, "Applied Botany Retrospective and Prospective"; William Trelease, "Some Twentieth Century Problems"; Charles R. Barnes, "The Progress and Problems of Plant Physiology"; W. G. Farlow, "The Conception of Species as Affected by Recent Investigations on Fungi"; Geo. F. Atkinson, "Experimental Morphology"; R. A. Harper, "Some Current Conceptions of the Germ Plasm"; F. C. Newcomb, "The Scope and Method of State Natural History Surveys"; Duncan S. Johnson, "The Evolution of a Botanical Problem"; Geo. P. Clinton, "Botany in Relation to American Agriculture"; H. M. Richards, "On the Nature of Response to Chemical Stimulation"; C. E. Bessey, "The Phyletic Idea in Taxonomy"; D. T. MacDougal, "Heredity and Environic Forces"; B. L. Robinson, "The Generic Concept in the Classification of Flowering Plants"; A. F. Blakeslee, "Sexuality in Mucors." Dr. Coulter in his address as president of the association spoke on "Botany as a National Asset."

In reading these addresses one certainly feels that a wide range of thought and investigation is covered. When I began to reflect on a topic suitable for an occasion of this kind, and suitable for one who has been engaged in trying to interest students and help to solve some of the problems confronting those who have to deal with the economic phases of our subject, it occurred to me that "some phases of economic botany" would give me a chance to offer some suggestions that might be a stimulus to bring together the varying interests of botany.

HUMAN INTEREST OF BOTANY

Botany should, first of all, have an intensely human interest from the standpoint of our well being. If we recognize this fact then plants should be studied not only for what use they may be to man directly and indirectly, but we must recognize also the cultural value of botany in schools, colleges and universities. Those who have had something to do with the park movement in the United States appreciate, of course, that the general interest in plants is really greater now than ever before. The layman to-day takes intense delight in the great out of doors and he does so for the pleasure he gets out of contact with nature. To such men and women a knowledge of plants becomes an intensely fascinating subject. They are becoming as truly cultured as the men or women who studied Shakespeare or any other of the great writers. This is a new culture which I think means much to the human race and our profession. It develops the highest instincts and elicits highest emotions. Let us not forget that the much despised taxonomic botany has a real place in our life, especially for those who have come to look upon the out of doors as a means to enjoy life.

EARLY ECONOMIC BOTANISTS

Let us take a little retrospective view of the subject. Botany began as an economic subject. Dioscorides, Pliny, Aristotle and Theophrastus were observers who gave to the world what they observed in the plant kingdom, largely on economic plants. Moreover they related in good form what previous writers had observed, with comments on culti-

vation. Theophrastus and Pliny both made some ecological observations which were destined to play an important part in investigations of the future.

WHAT THESE MEN OBSERVED

Let us frankly recognize the service these men rendered to increase our knowledge of plants. The plant pathology of these earlier writers was primitive of course and the plant pathologist of to-day would hardly class this early work under that term. This knowledge of the ancients was buried for centuries, in which little attention was given to botany or related subjects, but we may feel sure that during the "Dark Ages" man was intensely interested in the economic phases of botany although we have little written evidence of such interest. Botanists of long ago paid some attention to medical botany. We need only recall that such treatises as Gerard's "Herbal" and later the painstaking work of Hayne, "Die Arzneigewäshse," Rafinesque, "Medical Flora," and many others of the old writers up to the modern work of Millspaugh, "American Medical Plants," Kraemer, "Pharmacognosy," and Luerssen, "Handbuch der Systematischen Botanik," have kept us up with the times.

We know that the Crusaders brought from Asia and eastern Europe medicinal plants, cereals and fruits that made possible the highest type of civilization, for improved plants accompanied a revival of learning. We may be sure that during this epoch the economic phases of plants were studied because of the importance of increasing the food supply. The knowledge gleaned was passed on to the next generation to be of some use to man, and followed by the work of others who for the most part were observers, and our science, it must be said, began in observation. Men like Robert Morison, a close student of Cesalpino, Kasper Bauhin and others, added a little to the knowledge of previous botanists. John Ray and Francis Willoughby became interested in another phase of economic botany; they conducted experiments on the motion of sap in trees. Ray was generous to his predecessors like Grew, Jung and Malpighi. The old myth that wheat will degenerate in chess probably started with Ray, because he published a statement that *Triticum* could be changed into *Lolium*. Malpighi, the father of microscopical anatomy, gave a fair account of the structure of plants, including the ducts and the Malpighian cell. Economic plants always received special attention.

The English philosopher, Robert Hook, gave a fair account of cork, which he had studied with his improved compound microscope. He investigated the nature of food of plants.

Grew, in his "Anatomy of Plants," outlines in a masterly way the architecture of plants, interwoven however with the philosophical and theological prejudices of the time.

Bachman, who was a botanist, physiologist, pharmacologist and chemist, appreciated morphology and taxonomy. He introduced binomial nomenclature, and the reason given by him was that a prescription could be written easier. Think of it, that we as botanists are indebted to medicine for the naming of plants. Bachman refused to recognize cultivated varieties as species. Tournefort had only to go a step to recognize genera which he did in a splendid way. The last link in the chain of the botanists who were influenced by the older school was Linnæus, who borrowed from his predecessors like Cesalpino, Jung, Bachman and others, but always with fulsome praise of the work of his contemporaries and predecessors.

Sachs says:

> We are astonished to see the long known thoughts of these writers (Bauhin, Cesalpino, Jung), which in their own place look important and incomplete, fashioned by Linnæus into a living whole; thus he is at once and in the best sense receptive and productive.

Linnæus thought it important to know all species of plants. His "Philosophica Botanica" was a splendid text-book of botany. There was nothing else like it for more than a generation, at least there was nothing that equalled it in clearness and completeness. He

was not an experimenter and cared little for it. In Germany, under his influence taxonomy degenerated into mere plant collections, collectors calling themselves taxonomists.

POST-LINNÆAN BOTANY

A new era opened with such men as Jussieu, Gaertner, DeCandolle, Robert Brown, Adanson, Endlicher who knew how to observe and interpret the things they saw. Experimental work with plants became more important; botanists began to ask the why about plants; and so E. Mariette, one of the first experimental physicists, studied the salts of plants and the active forces of attraction and nutrition.

Martin Lister directed attention to the movement of water in plants. Christian Wolff, too, experimented on the nutrition of plants. Stephen Hales in his "Statistical Essays" sought to trace back the phenomena of vegetation to mechanico-physical laws, as then understood, and studied the water taken in by plants and its exit by the leaves and the formation of solid substances.

The discovery of oxygen by Priestley was important in plant physiology, but he missed the important discovery that light is a vital factor in making plant food. This was left to Jean Ingenhousz, whose experiments showed that purifying of air goes on in light only. This led him to study the food of plants and the improvement of soils. He discovered that plants use CO_2 and under the influence of light make plant food. Jean Senebier was the first to give a clear statement of the process of photosynthesis. We are indebted to the chemist, DeSaussure, for his discoveries, which laid the foundation in an experimental way of the process of food-making in plants. It is a long way from the researches of these pioneers to the work of Boussingault's quantitative methods of studying the food requirements of plants, especially with reference to nitrogen, and the work of Sprengel on ash constituents and Liebig's work, "Chemistry in its Relation to Agriculture and Physiology." These greatly helped to advance plant physiology, as did also the work of Lawes and Gilbert on the mineral constituents of plants and later the pot culture method of Knop, Sachs, and the work of Lachmann, who in 1858, spoke of the "Vibrionenartige" organisms found in leguminous nodules. Later the work of Schloesing and Muntz, Warrington, Beijerinck, Winogradsky, Hellriegel and Wilfarth and many others made secure for ever a better agricultural practise. Added to the knowledge of the importance of the legume bacteria the important discoveries of Wollny and Berthelot show that bacteria in the soil are the makers of plant food.

Plant physiological work in Europe made rapid strides through the labors of Detmer, Pfeffer, Sachs, Jost, Palladin, Haberlandt and many others. The question of photosynthesis long remained obscure because of insufficient chemical study of the plant pigments. The environmental factors were partially determined by F. B. Blackman and then Willstatter and his coworkers determined the chemistry of chlorophyll, which enabled plant physiologists to better understand the problems of carbon assimilation. Jorgensen and Walter Stiles in their résumé say:

> No prophetic vision is needed to foretell development in plant physiology as great as those which were produced by physics and chemistry in engineering and other technical sciences.

It is refreshing to observe that a soil physicist like Edward Russell in his paper "Soil Conditions and Plant Growth," should put stress on plant physiological problems as fundamental to a study of soils and plant nutrition.

Jung did not entertain any definite idea of the sexuality of plants nor did Grew have a clear conception. Rudolph Camerarius, however, settled the problem by making experiments with maize and mulberry, two economic plants.

We can only marvel at the economic trend of the work of Leewenhoek in the study of linen, who made the discovery of minute organisms, and thus repudiated the theory of abiogenesis. People became curious to study the hitherto unseen world. The use of the microscope in the hands of the curious was

not for scientific or practical purposes, but gave source to wild speculations in disease and the origin of life. However, its useful day came many years later, when its discoveries were made use of in many practical problems, connected with disease of plants and animals and the physiological problems in connection with crop production.

PLANT PATHOLOGY

Meyer, an extraordinary man who died at the age of thirty-six, published a work on phytopathology, a paper on corn smut and one on actinomyces. He was a physiologist and looked at the problem of disease from the standpoint of physiology, really the only way the subject should be treated. Camerarius seems to have antedated the work of Meyer by over one hundred years in the publication of his paper "De Ustilagine Frumenti." Julius Kuehn was primarily an agriculturist and as director of the Agricultural Institute at Halle started a series of experiments on plants that have become classic. While thus engaged in the work he became interested in a study of the diseases of plants. To him we owe the first comprehensive treatise on plant pathology. He had breadth of vision to study and interpret what he saw with the microscope and thus there came into being "Die Krankheiten der Kulturgewächse," which stands as a monument to his labors. It is the only botanical paper by him listed by Pritzel in his Thesaurus. M. J. Berkley's work, "Introduction to Cryptogamic Botany," gave to English-speaking people the first real treatise on plant diseases, which laid a sure foundation for a study of plants, along economic lines.

All of the work on plant diseases and the anatomy of plants was better established later through the classic work of DeBary. DeBary, of course, did not have, except in some cases, the practical problems in mind, though the science of botany and plant pathology in particular have been greatly benefited through his profound researches in connection with the development of life history of fungi. DeBary brought to the science of mycology a breadth of knowledge along many lines of botany and one marvels at the enormous amount of research work he did. Nor should we omit to mention the great work of Tulasne (who had the merit of first breaking the ground in a study of rust, smuts and ergot), on the discovery of the germination of the spores of rusts, smuts and the sexual organs of Peronospora. While these researches did much for mycology, indirectly they have been of great practical importance to pathology. Robert Hartig, perhaps the foremost student in the world during his lifetime of the diseases of forest trees and the decomposition of wood, exerted a great influence on the practise of forestry, followed later by the splendid work of Marshall Ward, a student of Hartig. We may mention in this connection the work of Fischer de Waldheim, Wolff, Sorauer, Appel, Millardet, Prillieux, Jones, Halsted, Arthur, Bolley, Atkinson, Stewart, Whetzel, Freeman, Clinton, Thaxter, Duggar, Stakman, Cook, Stevens and Melhus. These as well as a host of others, added to this economic phase of botany, making secure the science of plant pathology. I need only add here that the stimulus given by these men to this economic phase of botany has been communicated to all parts of the world; and so we may mention especially the pioneer work by Dr. Farlow on Gymnosporangium, grape vine mildew, onion smut, Dr. Burrill on apple blight and sorghum blight, the epoch-making researches along the line of bacterial diseases of plants by Dr. Erwin F. Smith. Surely America may well be proud of its achievements. The present age has hundreds of new problems in plant pathology. The superficial only was touched on by the early workers. We may mention especially the root disease of cereals and other crops. The plant pathological studies on these parasites has changed our methods of agriculture completely. We need more careful and profound work on many of the problems worked upon by the pioneers. The pioneers who blazed the way may be excused for errors, but the modern investigator should not be. He has the

equipment and money and should do good work.

POLLINATION OF FLOWERS

Another phase of the subject of economic botany is that of pollination. Progress was slow. Geoffroy, who as early as 1711 made some observations on the nature of the style, is said to have conducted some experiments with maize; however that may be he did make use of the work of Camerarius. Geoffroy concluded from various sources that fertilization was a kind of fermentation, but he was inclined to accept a second view of Morland that the pollen grains contain the embryo which find their way to the seed. We may also recall the work of John Logan, at one time governor of the colony of Pennsylvania, who conducted experiments on the fertilization of maize, in which he noted that cobs covered with muslin did not produce seed, but seed was formed on cobs where pollen came in contact with the stigmas. Logan suggested that the wind carried the pollen. Gleditsch in a study of one of the palms (*Chamœrops humulis*) strewed loose dried pollen on the stigmas of a female plant which produced seed which later was planted and germinated; a simple experiment but a convincing one to the botanists of the time, who had never seen pollination demonstrated before. Philip Miller in 1751 calls attention for the first time to the importance of insects in the pollination of tulips. The first scientific experiments on hybrids were made by Koelreuter, who discovered the use of nectar and the importance of insects in the pollination of flowers. Koelreuter clearly set forth the facts that the mingling of two substances produced a seed. These general statements as set forth by him still hold true. He was a skillful experimenter in the hybridizing of plants. The work of Sprengel on the pollination of flowers is well known to the older botanists. His sharp discriminating observations on the relation of insects to flowers were little understood at the time. The full import of these problems were recognized by Charles Darwin, who in his masterly way showed the application of this in practical problems. Earlier Sir Andrew Knight had demonstrated "that no plant fertilizes itself through an unlimited number of generations." Dr. Gray put this in a much more terse way. A score of investigators like Hermann Mueller, Fritz Mueller, Delpino, Ludwig Axell, Hilderbrandt and in our country men like Gray, Trelease, Riley, Foerste, Beal and Robertson demonstrated the use of insects in pollination and the application of this fact to important agricultural crops. These fundamental facts are fully recognized to-day in the growing of apples, alfalfa, sweet clover, melons, squash and cucumbers. The orchardist recognizes the importance of bees in connection with the growing of apples, pears and plums. The farmer recognizes the importance of bees in the alfalfa and sweet clover fields, just as Charles Darwin recognizes that the bumble bee is important in the red clover pollination. In this connection, as an economic problem, I may call attention to the honey flow in flowers. It is true beekeeping is only one of our minor agricultural problems dependent entirely on the relative abundance of honey plants in a given region. There are a great many interesting physiological problems in connection with nectar secretion, as Kenoyer has shown. One wonders why alsike clover scarcely yields any nectar for bees in Iowa and yet in some regions of the country it is one of the best of nectar plants. There is seldom any nectar in buckwheat flowers after 10:00 A.M. in Iowa, and yet in sections of the United States the period of nectar flow is much longer. Is soil alone a factor or is moisture an important factor, or are the two factors combined? We have enormous expanses of waste land along our highways in the United States, why not combine the esthetic with the economic if we can find plants that are suited for such places that will yield good returns for the beekeeper.

PLANT BREEDING

I heard a practical fruit grower in Iowa say the other day when a new chance seedling apple was shown me that nearly all of the new good things in the fruit line are chances; that

is to say the new productions by Burbank, Hansen, Patten, Beach, Hedrick, Webber and many other plant breeders are not equal to those found in nature. I need only recall the many fine things the modern plant breeder has produced. Of course, new types will always appear, as they have in the past. The work accomplished, it seems to me, will justify larger expenditure of money.

In the matter of fundamental study of these problems practical agriculture, horticulture and floriculture are indebted to the classic fundamental work of Hoffmeister and Strasburger. This work led up to and explains the physical basis of Mendelism discovered by Gregor Mendel, a work that is most important in the breeding of new types. We have had a host of botanical investigators who have enhanced our knowledge of plant breeding, linking it with practical work like Nilsson, Johannsen, Bateson, Correns, Shull, White, Webber and Emerson. Agriculture and horticulture are indebted to the epoch-making work of DeVries on mutation. His work has set a score of botanists to work on the pedigree culture work. I may mention Nilsson, Johannsen and Gates especially. Possibly the outstanding problem of the pomologist in states like Iowa and Minnesota is that of hardiness. In breeding experiments at the present time it is necessary to set the trees out and test them for a term of years, to see whether or not this climate is too severe. Bakke in some recent experiments has found that by ascertaining the depression of the freezing and the moisture content at a time when all the tissues are in an active state of growth, it is possible to obtain an idea of the comparative hardiness of different apple trees. These tests have been made upon trees in the nursery as well as upon trees in an orchard, 10 years old, with practically the same results.

SEED STUDIES

After a consideration of pollination the matter of seed is of importance. The first great work published is that of Gartner, "De fructibus Seminibus plantarum." Gartner was free from the bias of those who preceded him. We have a truly modern work by one whom we may regard as a modern man of science. He made a comparative study, correctly determined the relation of the endosperm to the cotyledon and named the embryo. We have had a long line of investigators on the subject of seeds.

The practical application found expression in the work of Nobbe, Harz and others. We may recall the work of Nobbe in the testing of seeds at the small experiment station at Tharand, which was the beginning of the experiment stations such as we know them today. Nobbe did not merely do the mechanical part in connection with the testing of seed, but inquired into real scientific problems in connection with specific gravity, and the vitality of seeds under different conditions of storing. The germination of many seeds is of special concern to the agriculturist, because it is important to know under what conditions a seed will germinate best to bring the largest returns. It is a matter also of some concern for the farmer to know whether weeds' seeds have a varying period of vitality when buried in the soil, whether for instance the seeds of *Hibiscus Trionum* and *Abutilon Theophrasti* will come up in his fields after a quarter or half a century when he practises rotation of crops. The vitality and structure of seeds has of course received much attention. I need only recall the classic work of DeCandolle who more than a century ago studied the prolonged vitality of seeds. The data secured by DeCandolle is frequently quoted in text-books of plant physiology. Also much later work of Becquerel, Beal, Ewart and Hanlein on delayed germination, as well as the work of Crocker and his students like Shull, on the delayed germination of seeds, like wild oats and other seeds of economic importance. To Crocker we are indebted for an explanation of the delayed germination of such seeds as the cocklebur. Knowing that there is a delay in some seed the farmer is better able to follow a rational practise in the treatment of seeds. I am sure that most of you are familiar with the work of Schleiden and Vogel, Chalon, Malpighi,

Haberlandt, Sempolwski, Beck, Moeller and Oesterle, Mattirolo and Buscalioni, Hanausek, Harz, Junowicz and many others who were interested in a study of seeds of Leguminosæ, particularly with reference to the light line. The writer more than a quarter of a century ago brought the literature on this subject together in his paper on the "Comparative Anatomy of Seeds of Leguminosæ." Comparatively little has been done since. Intensive studies on the seeds of such families as the Leguminosæ. Convolvulaceæ, Cucurbitaceæ, Malvaceæ, Tiliaceæ should be made because in most of these families where the light line occurs the seeds have a prolonged vitality. The subject has more or less of a practical bearing. The problem as to the nature of the light line in these seeds has not been solved. A number of present-day botanists, like Martin, Harrington and others are taking up the problem. Present-day investigations with seeds are bringing many valuable practical results in commercial seed production, as in clovers. The seed control work by the establishing standards of purity is a practical problem. The work in determining the conditions of germination, experiments with light, electricity, heat, moisture and drying and studies of seed coat are also important. The important problem of rate of maturing of seed in storage is being worked out. Seed-testing laboratories, while they are obliged to answer the immediate pressing problems on the impurities of seeds and their germination are engaged in a study of the more fundamental problems of the viability of seeds. It has been the custom for the American Seed Analysts Association to send to its co-workers seeds to test for purity and vitality. With careful treatment, there is still the greatest variation in the results. Presumably, in part at least, the methods used by seed testers is not the same and, therefore, the result can not be uniform. We should bear in mind that the viability is a matter of climate and condition of storage of the seed. The fundamental problems of every one of the great staple agricultural crops, so far as vitality of seeds is concerned, has not been entirely solved and awaits solution by the investigator.

The writer and Miss King, during the past few years, have continued investigations on germination of seeds of forest trees and shrubs. The results exhibit surprising irregularity and uncertainty in the germination of these seeds. Boerker, of Nebraska, has followed the same line of research. The work of Sir John Lubbock on Seeds and Seedlings and various papers of Tubeuf on seeds of forest trees, although purely morphological are always valuable for reference and bear in general upon forestry problems, of economic botany.

GRASSES

Botanists have long recognized the importance of grasses in our welfare. The prosperity of the United States outside of the rich natural resources of forestry, mines and water power is concerned with the economic production of cereals, cotton and livestock. Turning to some of the older works I recall the work of Sowerby and Parnell on grasses, Metzgar, "Die Gereidarten," Stebler and Schroeter, "Körnicke, Die Gebreidearten," and Hackel, "True Grasses." In our own country early works were Flint's "Grasses of Massachusetts," Klippart, "Grasses of Tennessee," Lapham, "Grasses of Wisconsin," Vasey, "Grasses of the United States," Lamson-Scribner, various papers published by the U. S. Department of Agriculture, Beal, "Grasses of North America," Hitchcock and Chase papers. These and other authors touching the economic problems of cereals, like Hunt, Carleton, Shear, Warburton and Ball have stimulated prduction but it would seem as though we have only scratched the surface so far as a study of the real problem of cereal production is concerned. It vitally concerns us as a nation to stimulate the production of cereals and forage crops because the ever-increasing population demands increased production. How can the botanists contribute more to the welfare of mankind than to study such problems as the physiology of the nutrition of the growing of wheat, maize, oats, barley and rice, or to make a study of pollination

under different climatic conditions, or the breeding of varieties of cereals resistant to diseases? We might well consider the stupendous losses from parasitic fungi of cereals. There never was a time when research on cereals and other agricultural crops was as important as it is to-day. We have, on a large scale, undertaken the removal of the barberry in the wheat-growing section of the country, because the plant pathologists are convinced that the common barberry is an important factor in rust production. And yet, I was confronted with the frequent statement by practical men in western Minnesota that there is no barberry in this particular section. I certainly saw none in the immediate area to speak of, although there was some barberry thirty miles to the south. I could not make the questioner see the importance of the barberry in connection with grain rust. Some seasons no doubt there are actually viable uredo spores on grasses. The point, I think, we should determine to convince the wheat grower on is this: are the uredo spores viable in weedy grasses, and how far can the uredo spores be carried? The farmer who loses $3,000 on a quarter section of land in a single year of wheat-growing wants some solution of the problem. It is the duty of the government and the botanist to solve the problem for the country. Unless this is done by exterminating the barberry, the breeding of resistant varieties and the elimination of weedy grasses, the growing of spring hard wheats will be a thing of the past, and the farmer will be forced to turn his attention to the growing of other cereals, not subject to rust. The government and the states directly interested, can well afford to spend a half million dollars annually until the problem is solved.

WEEDS

The subject of weeds is related to that of plant disease. It greatly interests the farmer and gardener. The farmers of the United States, at least in some sections, have endeavored to remove by legislation some of the injurious weeds, expecting, of course, that the law would be obeyed and the weeds would soon be eliminated, but instead they are constantly increasing. As illustrations of weed legislation I need only remind you that some twenty-five years ago nearly all the northwestern states made it illegal to permit Russian thistle to grow. During these twenty-five years it has spread from the Atlantic to the Pacific. In Washington and Colorado where the conditions are suitable it covers the ground on little travelled roads and on the plains. In Iowa we made an effort by legislation to reduce the infested areas of quack grass, but it has so increased that the farm values in some cases are reduced because of its presence. During the past two seasons I have received a large number of specimens of knapweed (*Centaurea solstitialis*) from many points in Iowa and northern Missouri, distributed largely through alfalfa seed. Buckhorn (*Plantago lanceolata*) is rapidly interfering with clover culture in Iowa.

We have described weeds and how to eradicate them, because this is the kind of information the farmer wants, but we have not solved a single one of the important problems in connection with weeds. Weeds have an important bearing on the crops produced. The small ragweed no doubt reduces the efficiency of the Iowa pasture during the autumn months fully one half, the weeds of corn fields frequently cut the yield one third. How these yields are reduced has not been determined. How much do we know about the mechanical interference of weed roots and the agricultural crop? So far as I know, there is absolutely no data on the subject. Water is an important factor in crop production; therefore, a study of transpiration is of importance in connection with a study of weeds. It has been pointed out by Livingston that transpiration is practically a simple function of the leaf surface and that the total transpiration is a measure of the growth of a plant, whether it is one growing in a waste place or of economic importance.

Kesselback makes it clear that weeds such as sunflower use more than three times as much water per plant as corn. while water used per

unit of dry matter was slightly more than double that of corn. In other words, a sunflower plant will consume as much water as a hill of corn. Brenchly in a recent publication states that weeds like mustards did better when they were associated with other plants, than when they were subjected to competition with their own species. Wheat is not so well able to overpower the *Brassica* and reduce its growth as is the case with some other weeds. Mustard would then, according to Brenchly, even in moderate amounts do considerable damage.

Possibly in the majority of places, even in the agricultural areas of the middle west, there are times in which there is not enough water to supply the needs of the plant. Water is used by a plant in large quantities and practically all of it passes off in the transpiration stream. Water being an important item, its conservation is a question which we must be concerned with. From the few citations given above we conclude that weeds do considerable damage to growing crops by consuming the moisture. Knowing that transpiration or the giving off of water by the aerial portions of a plant goes hand in hand with the leaf area, a study in which the leaf area and transpiration are measured from time to time at specific intervals should give us much information concerning the effect of weeds upon the crop in which they are associated, both in the greenhouse and in the field.

Some preliminary work done in plant physiological laboratory at Ames by Bakke shows that the matter of transpiration by weeds is an important item in crop production. In these experiments wheat, oats and mustard were grown together and, with one exception, it was found that the total transpiration for the mixed cultures is greater than for the pure wheat and oats cultures. The present study shows that wheat transpires during the growing season more than oats.

ECOLOGICAL PROBLEMS

Another phase of economic botany has interested me very much, namely the relation of plants to soil. This requires the best kind of taxonomic work if the ecological investigations are to be correctly interpreted. The national government in cooperation with various states is spending large sums of money to study soils. It is a good kind of investigation. The soils are carefully mapped on a scale as never before. The plant is an index of what the soil will produce and the aim of this work is to help the farmer. I am sure it does; and why should the botanists not cooperate with the geologist, and the soil expert make just as detailed a study of the plant life as the geologist does of the soil. In no place in the world can this problem be studied better than in the prairie states. There is scarcely anything left of the great prairie domain, except as we find it along the right-of-way of railroads. Should not a group of botanists in these prairie states study the ecological and taxonomic phases of the richest, virgin, agricultural soil in the world, as Shimek is now doing for the prairie plants of Iowa. What we need is a crop ecologist, who after a study of the problem, can tell the farmer just what crops can be grown together or what crops are best suited for his soil. Let us as botanists seek a closer cooperation with the soil expert.

I am reminded that Dr. Cowles in an address before this section called attention to the use of an ecologist to settle a legal question involving a large amount of money in regard to a meandered lake in Arkansas where a study of the problem by the ecologist disclosed the truth that the so-called lakes had been covered with trees much antedating the survey made by the government. I am told that in some surveys along the Mississippi the government instructions are to include all land to the limit of apparent line of vegetation. Who should determine the apparent line of vegetation; the surveyor, who generally knows nothing about succession, or the ecologist? It would seem to me, the ecologist.

EROSION

In a prairie state like Iowa every available area has been brought under cultivation, or the wooded areas have been turned into

pastures. Millions of dollars worth of the very best soil in this great agricultural region are annually carried down the Mississippi, finally helping to increase the area of Louisiana, or to fill up the channel of the Mississippi River. The government to prevent disastrous floods builds levees. The water, under our present system of intensive agriculture, is rushed off as rapidly as possible, the little lakes are filled up with silt from the neighboring drainage area or they are drained. Drainage no doubt does help crop production but the water table has dropped twelve feet, according to McGee, in fifty years in Iowa. Now if the water table will show a further drop it is a question of vital concern to the agriculture of Iowa. Have we any plant physiological data to show how this has influenced crop production or the growth of trees? The botanist can do a real service by making a study of the movement of water in the soil and its relation to plant growth. We know that the climatic and edaphic relations of forests are important. Zon has given us a comparative study of the problem in his paper on "Forests and Water in the Light of Scientific Investigation." Then we may also recall the work of Pearson on the "A Meteorological Study of Parks and Timbered Areas in the Western Yellow Pine Forests of Arizona and New Mexico." and the work of Hall and Maxwell, Bray and Schwartz on forests and streams flow.

In order to determine the problem of water conservation and forest conservation, I. T. Bode made an investigation in one of our park areas in Iowa. The results are interesting, as showing the close relationship between forest cover and soil moisture. The results show unmistakably, even in a small area, that the forest cover keeps greater quantities of water in the upper soil layers, that these forest areas maintain a higher water level in the soil.

The conclusion to be drawn from the work and some done by others of the Forest Service is that all hills subject to erosion should be covered with timber.

AQUATIC FARMING

I have been more or less interested in the preservation of our lakes, not only because the community and state will receive the benefit of recreation, but our lakes and streams should furnish an important source of food, and also a source of income from the fur-bearing animals. The botanist should make more study of the food for fish and game. It is said that the little muskrat in Iowa has become so depleted that it will be necessary to have a closed season. Much of this depletion is no doubt due to trapping, but may not the food supply have some bearing on the problem? Take for instance the water-lily, which has become a somewhat rare plant in Iowa. How far does this plant and the lotus minister to the food of this little rodent? Sportsmen are agreed that wild rice and wild celery are very important food plants for the wild duck. Schofield has given us a practical method of germinating wild rice, yet we know almost nothing about the maximum yield of this plant and how it might be increased. There are millions of acres of land suitable for the growing of wild rice in the United States, especially in the northern Mississippi valley. It should be used more extensively for human food than it is to-day. We know little about the uses of aquatic plants by animals. May we not breed a variety of wild rice which will cling somewhat more tenaciously to the rachis? Some plant breeder should undertake the selection of plants with this in mind.

COOPERATIVE WORK

We have never in the history of the world had as much productive research work as now, although there may be a slight curtailment since the war. Our various journals, like the *Botanical Gazette*, *American Journal of Botany*, *Bulletin Torrey Botanical Club*, *Journal of Agricultural Research* and various publications from experiment stations, national government and academies of science are publishing an enormous amount of good material. All state, national and private agencies are working to increase the amount

of research. Cooperation seems to be the slogan to-day and the National Research Council, created as a war measure, is functioning to stimulate research in all of these institutions of the country in a cooperative way. Botany certainly has not been neglected as evidenced by the fundamental physiological work on fertilizers and the growing of wheat, and the fundamental work in connection with the treatment of plant diseases which will be taken up by the Research Council through the Crop Protection Institute in a cooperative way. Cooperation in every line is desirable, but is it not a fact that all great discoveries are made by individuals? These individuals should have plenty of equipment and help, and each should have a free hand to work out his or her problem.

In conclusion the plea I desire to make is that the botanist should enter more vigorously into the exploitation of fields of agronomic work, ecology and taxonomic work, as it is related to horticulture and agriculture. We have allowed some splendid fields of work to slip away from us, largely because we were indifferent to the problems of agriculture. This is not true of plant pathology which has made itself felt along economic lines. It is true that some phases of plant breeding, physiology and soil relations of plants are masquerading under various forms of agriculture and horticulture. It is not my aim to belittle much that has been accomplished by horticulturists and agriculturists, but this work, when botanical, should finds its place under the head of botany. Let us look for a new era in botanical work. Then the various phases of the work will find their rightful place, not only in our teaching, but in our research as well.

L. H. Pammel

Iowa State College

SCIENTIFIC EVENTS

THE BOWDOIN MEDICAL SCHOOL

The Bowdoin Medical School, established a century ago by Maine's first legislature, will be closed as a department of Bowdoin College at the end of the current year next June, unless by that time it receives financial support.

The following announcement has been made by President Kenneth C. M. Sills by authority of the boards of trustees and overseers.

By action of the board of trustees and overseers the Bowdoin Medical School will be finally closed as a department of Bowdoin College at the end of the current year, June, 1921, unless by that time some way shall be found to meet the requirements necessary to keep the school in Class A of American medical colleges. It has been conservatively estimated that for this purpose there must be an addition to the resources of the school of $25,000 for immediate equipment of laboratories and of at least $50,000 yearly income for more teachers and for up-keep. Unfortunately at the present time the college sees no way of procuring such funds; the need of such an endowment has often been placed before the people of Maine, but the appeals have never received an adequate response.

The college will not apply for state aid for the school. But if the citizens of Maine and the friends of medical education who believe that the maintenance of a medical school is properly a state function, desire to have the medical school reestablished as a state institution under state control and adequately supported by the state, Bowdoin College will be glad to give all assistance possible to that end, and would doubtless offer for such a purpose for temporary use, if desired, such part of the buildings and apparatus of the college as might be available.

The trustees and overseers of the college believe that there is a place for a medical school in Maine and are hopeful that the people of the state, despite the great demands on the incoming legislature, will establish such a school as a state institution, around which all the medical and public health work of the state would be centered.

THE DIRECTORSHIP OF THE BUREAU OF MINES

Dr. F. G. Cottrell, director of the United States Bureau of Mines, on December 31, handed his resignation to the President, through Secretary of the Interior Payne. He leaves the bureau to take up his duties as chairman of the Division of Chemistry and Chemical Technology of the National Research Council. Dr. Cottrell recommends as his successor H. Foster Bain, of California, whose

name was formally presented to the President. In his letter of resignation, Dr. Cottrell said:

> I hereby tender you my resignation as director of the Bureau of Mines, to take effect January 1, 1921.
>
> In so doing, may I recall to your mind that, in accepting this position upon the resignation of Director Manning last June, I explained to the secretary of the interior that I had previously made all my plans to resign from the position I then occupied as assistant director and to give my undivided attention to the position of chairman of the Division of Chemistry and Chemical Technology of the National Research Council, which I had accepted as successor to Professor W. D. Bancroft, who was retiring July first.
>
> I accepted appointment as director of the Bureau of Mines on the understanding with Secretary Payne that I would continue therein until an available successor should be found who was thoroughly acceptable to him and to the mining industry.
>
> The time having now arrived when Secretary Payne is ready to recommend a successor, I am placing my resignation in his hands for transmittal to you.
>
> It is with the pleasantest recollections that I look back over my decade of service in various capacities within the bureau, and as the greater part of this time has fallen within your own administration, it gives me particular pleasure to tell you of the uniform courtesy and high standard of public service which I have always encountered in my contact with both associates and superiors throughout the whole department.
>
> It would be with very deep feelings of personal regret that I should take the present step were it not that the position in the Research Council will still permit me to cooperate very closely with those particular aspects of the bureau's work for which I feel myself best fitted.

At the same time Secretary Payne handed to the President the appointment of H. Foster Bain, of California, as successor to Dr. Cottrell.

Mr. Bain was educated and trained as a geologist and mining engineer. He was one of Herbert Hoover's assistants in London on the Belgian relief work during the war. Before that he was editor of the Mining and Scientific Press of San Francisco, Calif., and later the editor of the Mining Magazine of London, England. He made some important mining investigations in south and central Africa and later undertook similar investigations in China. At one time he was a mine operator in Colorado and once was connected with the United States Geological Survey. Subsequently, he was the first director of the Geological Survey of Illinois. For a time during the war Mr. Bain was assistant director of the United States Bureau of Mines, following up production and manufacture of metal products, explosives, and other chemical substances for war purposes. At the close of the war Mr. Bain returned to private life. Mr. Bain was born at Seymour, Indiana. Graduating from Moore's Hill College, Indiana, in 1890, he spent two years at Johns Hopkins University and later received his doctor's degree from the University of Chicago.

INTERNATIONAL EUGENICS CONGRESS

In 1912 there was held in London, under the auspices of the Eugenics Education Society, an International Eugenics Congress. A second congress was planned to be held in New York City in 1915 but, on account of the war, plans for the congress were abandoned. In the autumn of 1919, at a meeting of the International Committee of Eugenics held in London, it was agreed to hold the second International Congress in New York City in 1921. A general committee to arrange for this congress was selected by the National Research Council in the spring of 1920, and it is now announced that the preliminary announcement of the Second International Congress of Eugenics will be held in New York City, September 22–28, 1921.

Of this Congress Dr. Alexander Graham Bell is honorary president; Dr. Henry Fairfield Osborn, president; Mr. Madison Grant, treasurer; Mrs. C. Neville Rolfe (Mrs. Sybil Gotto) honorary secretary; and Dr. C. C. Little, secretary-general. The vice-presidents include Dr. Cesare Arton, Cagliari Italy; Dr. Kristine Bonnevie, Institute for Heredity Investigation, University of Christiania, Norway; Major Leonard Darwin, London; Dr. V. Delfino Buenos Aires; Dr. E. M. East,

Harvard University; M. Gamio, Director Archeology and Anthropology, Mexico; Sir Auckland Campbell Geddes, British Ambassador to the United States; Dr. Corado Gini, Rome; Hon. Mr. Justice Frank E. Hodgins, Supreme Court of Ontario; Dr. Fréderic Houssay, Paris; Dr. H. S. Jennings, Johns Hopkins University; G. H. Knibbs, Melbourne; Dr. Herman Lundborg, Upsala; Dr. L. Manouvrier, Paris; M. L. March, Paris; Dr. Jon Alfred Möjen, Christiana; Dr. T. H. Morgan, Columbia University; Dr. R. Pearl, Johns Hopkins University; Dr. Edmond Perrier, Paris; Dr. Ernesto Pestalozza. Rome; Dr. V. Guiffrida-Ruggieri, Italy; Professor R. Vogt, University of Copenhagen; and Professor Wille, University of Christiania.

The Finance Committee has been selected consisting of Messrs. Madison Grant, John T. Pratt, Austin B. Fletcher, and Dr. John H. Kellogg. Of the Exhibits Committee Dr. H. H. Laughlin is chairman; of the Publicity Committee, Dr. Lothrop Stoddard; and of the Executive Committee, Dr. C. C. Little. A general committee of ninety-five members has been appointed. There are to be two classes of members, sustaining members paying one hundred dollars and active members paying five dollars. Further information and a copy of the preliminary announcement can be obtained from Dr. C. C. Little, Secretary-General, American Museum of Natural History, New York City.

THE AMERICAN ENGINEERING COUNCIL

THE Engineering Council, formed in 1917 as an emergency body to place at the disposal of the government in war the organized engineering talent of the nation, has been formally merged into the American Engineering Council of the Federated American Engineering Societies.

Mr. Herbert Hoover, who becomes president of the amalgamated organizations, and the four vice-presidents, Calvert Townley, of New York; William E. Rolfe, of St. Louis, Dean Dexter S. Kimball, of Cornell, and J. Parke Channing, of New York, have issued a statement in which it is said that the new council will immediately enter upon a campaign of public service, involving cooperation with chambers of commerce, labor organizations and other bodies in an effort to solve pressing social, industrial and political problems.

The appointment of several committees to handle national problems is announced. One on military affairs is headed by Colonel William Barclay Parsons, chairman of the trustees of Columbia University. D. L. Hough, of New York City, has been named to head a Russian-American committee, which, it was explained, is in no sense political, but will aim to bring the engineers of the United States and Russia closer together. A patents committee, which will work for an increase in both the pay and personnel of the United States Patent Office, has been appointed, with E. J. Prindle, of New York as chairman. Other committees chosen thus far are: Classification and Compensation of Engineers, Arthur S. Tuttle, of New York, chairman; National Board of Jurisdictional Awards in the Building Industry, Rudolph P. Miller, of New York, chairman; Cooperation with American Institute of Architects, S. H. Senehon, of Minneapolis, chairman; Payment for Estimating, Ralph Modjeska, of Chicago, chairman; Types of Government Contract, Arthur P. Davis, of New York, chairman. These committees, with others to be appointed, will start at once to carry out a constructive program of national progress.

SCIENTIFIC NOTES AND NEWS

IN 1816, John Scott, a chemist of Edinburgh, bequeathed the sum of $4,000 to the City of Philadelphia, the interest upon which was to "be laid out in premiums to be distributed among ingenious men and women who make useful inventions." The Board of Directors of City Trusts of Philadelphia, has awarded $800 together with a bronze medal to Dr. Hideyo Noguchi, of the Rockefeller Institute, for Medical Research in New York, "in recognition of his eminent work in the discovery of disease-producing organisms and the means of combating their action." A similar award has been made to Dr. Edward

Calvin Kendall, of Rochester, Minn., "For biochemical work of high order leading to the preparation of the compound 'thyroxin' and the determination of its chemical structure and giving results which contribute to the comfort and welfare of mankind."

Professor Stephen A. Forbes, of the University of Illinois has been elected president of the Ecological Society of America.

At the recent Chicago meeting of the American Psychological Association, Professor Margaret Floy Washburn was elected to the presidency.

Dr. William Blum, of the Bureau of Standards has been elected president of the Washington Section of the American Chemical Society.

Dr. F. M. Perkin has received the honor of the order of commander of the British Empire. Dr. Perkin is one of the leading authorities upon the scientific treatment and utilization of coal and the production of oil from it.

The Italian Society of Sciences has awarded its gold medal for 1920 to Professor A. Signorini, of the University of Palermo, for his papers published during the last year.

Dr. C. O. Johns, chief of the color and protein laboratories of the Bureau of Chemistry of the Department of Agriculture, has resigned to accept the offer made him by the Standard Oil Company of New Jersey, to be director of the research laboratory of the company.

Mr. H. D. Foster has been appointed research associate at the Bureau of Standards by the Hollow Building Tile Association.

Assistant Surgeon-General J. H. White, U. S. P. H. S., after the close of the sixth Sanitary Conference of the American Republics, to be held in Montevideo, Uruguay, will proceed to Valparaiso, Chile, and other points on the West Coast of South America, via Panama, for the purpose of investigating sanitary conditions at the various ports.

Commander Cope, leader of the British Antarctic Expedition, is detained in Montevideo through the non-arrival of his dogs. He is also encountering difficulty in obtaining films owing to their unexpected cost. He proposes to give lectures at Montevideo and at Buenos Aires, thus obtaining assistance from the British communities. He will probably proceed south early in December in the whaler *Solstreif,* without waiting for the dogs, although their absence makes sledging more difficult.

Professor J. W. E. Glattfeld, of the department of chemistry of the University of Chicago, will spend his winter quarter vacation at the Desert Laboratory of the Carnegie Institution at Tucson, Arizona.

Dr. Julius Stieglitz, of the University of Chicago, has delivered three lectures on the Mayo Foundation at Rochester, Minnesota. The first was on "Chemistry and Medicine," and the other two were on "The Electrical Theory of Oxidation."

A lecture was delivered at the School of Hygiene and Public Health of Johns Hopkins University, December 13, by Dr. Charles Wardell Stiles, U. S. P. H. S., on "Some Practical Aspects of the Subject of Soil Pollution."

Dr. Alfred F. Hess, of the New York University and Bellevue Hospital Medical College, will deliver the fifth Harvey Society Lecture at the New York Academy of Medicine on Saturday evening January 15. His subject will be "Newer Aspects of Some Nutritional Disorders."

Dr. Yves Delage, professor of zoology in University of Paris, distinguished for his work on protoplasm, heredity and general biology, has died at the age of sixty-six years.

Professor G. M. Debove died on November 19, at almost seventy years of age. He is known for his work on diseases of the stomach and for the past seven years has been permanent secretary of the Paris Academy of Medicine.

At the annual meeting of the Society of American Foresters held in New York City

on December 20, the following officers were elected for 1921:

President, R. C. Bryant, 360 Prospect St., New Haven, Conn.

Vice-president, Paul G. Redington, Ferry Bldg., San Francisco, Calif.

Secretary, Paul D. Kelleter, Atlantic Bldg., Washington, D. C.

Treasurer, E. H. Frothingham, Atlantic Bldg., Washington, D. C.

AT the recent meeting of the Indiana Academy of Sciences the officers were elected for 1921 were as follows:

President, Howard E. Enders, West Lafayette.

Vice-president, Frank M. Andrews, Bloomington.

Secretary, Walter N. Hess, Greencastle.

Assistant Secretary, H. G. Dietz, Indianapolis.

Treasurer, Wm. M. Blanchard, Greencastle.

Editor of Proceedings, F. J. Breeze, Muncie.

Secretary, F. B. Wade, Indianapolis.

THE American Pharmaceutical Association has elected the following officers:

President, Samuel L. Hilton, Washington, D. C.

First Vice-president, Charles E. Caspari, St. Louis, Mo.

Second Vice-president, David F. Jones, Watertown, S. D.

Third Vice-president, Hugo H. Schaefer, New York.

Members of the Council, Henry M. Whelpley, St. Louis, Mo.; George M. Beringer, Camden, N. J.; John G. Godding, Boston, Mass.

THE U. S. Civil Service Commission has announced examinations for the positions of junior engineer and deck officer in the U. S. Coast and Geodetic Survey to be held February 9–10 and April 13–14, 1921. These positions are the entering ones in the field force of the Coast and Geodetic Survey and the initial salary will be $2,000 per annum, with a promise of increase to $2,400 after one month of satisfactory service. From these entering positions engineers will be promoted after six months of satisfactory service to the commissioned grades of the Survey which have relative rank with the grades from ensign to captain in the navy. The salaries of the commissioned personnel, including compensation for quarters, etc., and longevity pay, vary from a minimum of $2,500 to approximately $7,000 per annum. There are now about fifty vacancies in the commissioned grades which will be filled by promotion from the eligibles secured from the examinations to be held in February and April. Applicants for this examination should communicate with the Civil Service Commission or with the Director of the Coast and Geodetic Survey, Washington, D. C. A civil engineer degree or B.S. in civil engineering is required of an applicant before appointment, but the examination may be taken in February or April and the appointment made effective on graduation.

THE Laws Observatory of the University of Missouri, erected in 1853, has been torn down, and a new building is being erected to replace it about half a mile south of the former site.

INCLUDED among the bequests of the late Dr. Lloyd Roberts of Manchester, England, are the following gifts to medical organization: to the Royal Society of Medicine, £5,000; to St. Mary's Hospital, Manchester, £5,000; to Manchester Royal Infirmary and to the Royal College of Physicians, London, £3,000 each; and £2,000 to the Medical Society of London.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Montpellier, which was founded in the thirteenth century, is preparing for the celebration of its approaching seven hundredth anniversary.

THROUGH the death of Mrs. Lucy H. Bowdoin, of Salem, a bequest of $50,000 becomes available for Harvard Medical School, and $5,000 each will be given to the Essex Institute and Peabody Academy of Salem.

IT is planned to establish a technical school at Oberlin College with accommodations for about 700 students.

FIRE, supposed to have originated from the furnace in a basement room, completely destroyed the office and private laboratory of Dr. Waddell, professor of pharmacology, and a large amount of physiological apparatus in the physiological laboratory of the University of

Virginia on the morning of December 24. The loss is largely, if not entirely, covered by insurance and there will be little interruption to the regular laboratory work.

The inauguration of President Wallace D. Atwood, of Clark College, will take place on February 1. Presidents and representatives from more than two hundred colleges have signified their intention of being present at the exercises.

Dr. Henry Rand Hatfield, professor of accounting on the Flood Foundation in the University of California, has been appointed dean of the faculties of the State University of California to succeed Professor John C. Merriam, who resigned to accept the presidency of the Carnegie Institution in Washington.

At the College of the City of New York, Professor Herbert R. Moody has been appointed professor of chemical engineering within the department of chemistry; Assistant Professor W. L. Prager has been promoted to an associate professorship, and Mr. Joseph A. Babor has been promoted to an instructorship.

Dr. Ardrey W. Downs, formerly assistant professor of physiology at McGill University, has been appointed to the chair of physiology in the University of Alberta.

DISCUSSION AND CORRESPONDENCE

ANTHROPOMETRIC MEASUREMENTS

During the sessions of two International Congresses of Anthropology, in 1906 at Monaco, and in 1912 at Geneva, rules were drawn up for the standardizing of the more usual anthropometric measurements. The work was undertaken in each case by a committee, and the official reports were published by certain members to whom this duty was assigned.

The prescription of 1906 included measurements of the skull and of the head and facial features of the living. It was published in the French language by Dr. Papillault and appeared in the pages of *L'Anthropologie* (Vol. 17, 1906, pp. 559–572). The prescription of 1912 was the work of a larger and more representative committee, which aside from French, German and Italian members, included representatives of Great Britain, the United States, Russia, and Switzerland, countries not included in the former report. The official reporters of this prescription, which included measurements of the living body, exclusive of those of the head and face, were Drs. Rivêt, Schlaginhaufen and Duckworth, who published their reports in French, German and English, respectively.

Having these data in mind I was led to state, in the preface to my recent "Manual of Anthropometry," that the official reports of the prescription of 1912 were published only on the other side of the Atlantic, and appeared in an American journal for the first time in 1919, when Dr. Duckworth's official report was reprinted by Dr. Hrdlička in his new *American Journal of Physical Anthropology*.

While this statement, concerning the three *official* reports only, is strictly true, I should have mentioned that equally accurate and trustworthy reports were published in other countries, and especially should I have cited that of Dr. MacCurdy, also a member of the committee. His report in full of the prescription of 1912 was translated at the time of the Congress for Dr. Rivêt's official copy, and appeared, later in the same year, in both Science and the *American Anthropologist*. Had I noticed this earlier, I should certainly have brought it to the attention of the readers of my book, and wish to take this opportunity to rectify my unintentional neglect.

The citations referred to are the following:

Science: N. S., Vol. 36, No. 931, Nov. 1, 1912, pp. 603–608.

Amer. Anthropol., Vol. 14, No. 4, Oct.–Dec., 1912, pp. 621–631.

Harris Hawthorne Wilder

Smith College,
Northampton, Mass.,
December 17, 1920

A NEW DIKE NEAR ITHACA, N. Y.

Considerable attention has been given by geologists to the dikes of central New York.

Each newly discovered one is of interest and perhaps a note should be made of the occurrence of a rather large dike recently found. It has been exposed at the eastern side of the Portland cement quarry east of Shurger Point, six miles north of Ithaca. It is the first of the Ithaca region dikes found in limestone and is exposed for the height of the Tully limestone at the north and south walls of the quarry and in the shales along the quarry bed.

No contact action was noticed. In places there is a thin calcite streak at the side of the dike, in others there is a tight contact between dike and wall rock. Striæ on the calcite gave evidence of horizontal movement. The dike varies in width from 11″ to 18″ and is decidedly green, due to the serpentine in it. It strikes about N 3° E., parallel to the dip joints, like all the dikes near Ithaca. There may be some connection between this dike and a group of smaller dikes east of Ludlowville, two miles to the north.

Pearl Sheldon

Cornell University

THE HAWAIIAN OLONA

To the Editor of Science: In Science[1] for September 10, 1920, p. 240, Mr. Vaughan MacCaughey again calls attention to the remarkably durable fiber of the Hawaiian Oloná, and quotes Dr. N. Russel's rather inaccurate account of the people making the fiber and its products, fish nets and cords, some used especially for fish-lines. In view of the possible importance of this product, it seems worth while to correct certain statements. The name of the bird caught for its yellow feathers was O-o not O-u. As late as 1864, when the present writer first visited the Hawaiian Islands, there were some natives at Olaa still beating the mamake kapa and twisting the oloná fiber on their thighs. On the island of Molokai, as late as 1889 a photograph was taken of a native scraping the fiber. Surely Mr. MacCaughey must be aware that in the Bishop Museum in Honolulu, is a fine cast from life of a native preparing this fine fiber, and there are many specimens of both the raw material, the finished product and the *laau kahiolonú* or scraper which was sometimes a shell *papaua* (*Meleagrina margaritifera*) but more commonly a sharpened bone from the back of the *honu,* a sea turtle not a (fish, as Dr. Russel has it). The boards were made of any hard wood; the *naou* of Dr. Russel was perhaps the *naio,* or bastard sandalwood.

As a specimen of the remarkable durability of the fiber, there is in the Bishop Museum a ball of fish-line used by the Kamehamehas for a hundred years and it is still in perfect condition.

William T. Brigham

[1] N. S., Vol. LII., No. 1341.

QUOTATIONS

PROFESSOR MICHELSON ON THE APPLICATION OF INTERFERENCE METHODS TO ASTRONOMICAL MEASUREMENTS

The first information Professor A. S. Eddington, Plumian professor of astronomy at Cambridge University, received that his theoretical deductions concerning the angular diameters of certain stars and of the Betelgeuse, in particular, had been confirmed by Professor Michelson [in his paper at the Chicago meeting] was from a cable message from the *New York Times.* He was extremely interested and delighted at the results obtained and is anxiously awaiting full details.

Talking to the *New York Times* correspondent he pointed out that many years ago Professor Michelson suggested a plan for measuring, at any rate to a much greater degree of accuracy than before, diameters of stars by the wave theory of light.

"For some time now," he said, "they have been carrying on these experiments at Mount Wilson, and I presume that it is there that these most interesting results have been obtained. The great difficulty that they have had to contend with has, of course, been what is known as atmospheric tremor. They have been trying Michelson's methods and previously had obtained some very interesting results, but these were only with regard to very close double stars. By this means they got some very successful results with double stars, but when they

came to try to determine the angular diameter of stars they were up against a very much more difficult problem. I knew that they were working on these lines, but this is the first word I have heard of the results.

"At a meeting of the British Association I delivered a presidential address to the mathematical and physical sections, and made reference to the fact that this experiment which was being carried out would be of the very greatest importance. We have of course had theories, and, working on those theories, I gave a table of what I thought would be the angular diameter of certain stars, and I am delighted to find that the figures so nearly correspond. This would seem to show the theories have been on the right side.

"In particular, I noticed that Betelguese's diameter is 260,000,000 miles, which is enormously larger than the sun. That is a very interesting confirmation of the theory of Russell and Hertzsprung of giant and dwarf stars, giving direct evidence that Betelguese is one of the inflated stars and very different from the sun."

Dr. A. C. Crommelin, chief of staff of the Greenwich Observatory, was interviewed today on Professor Michelson's discovery by *The Evening Standard* and expressed the interest the experts in England's principal observatory took in it.

"Star diameters have been calculated hitherto," he said, "but have never before been actually measured. Michelson's announcement that he has measured Alpha Orionis and found it to have a diameter of 260,000,000 miles, 300 times bigger than the sun, is hopeful.

"That the distance from the earth of such a star as Alpha Orionis, which is 900,000,000,000,000 miles away, should have been measured so long ago and the size of the star should remain unmeasured seems strange, but it was explained at the offices of the Royal Astronomical Society that the two measurements have to proceed on entirely different lines.

"The Astronomical Society confirms Dr. Crommelin in the expectation of good results from Professor Michelson's work. For some time past he and his work have loomed increasingly large in the astronomical world.—Cablegram to the *New York Times*.

CAUSES OF CLIMATIC OSCILLATIONS IN PREHISTORIC TIME, PARTICULARLY IN THE ICE AGE[1]

In 1918 Professor Arldt, of Radeberg, grouped the theories and weighed the evidence which had been proposed by 117 scientists in the past sixty years on the causes of the glacial and interglacial epochs. As none of these hypotheses are in all respects satisfactory, in his opinion, or can claim to explain thoroughly all paleo-climatic phenomena, he does not recognize any one theory or group of them. This is not surprising since the fundamental conclusions underlying these hypothesis have not been reached.

In this paper of twenty-seven pages, Arldt does not give an exhaustive explanation of the numerous hypotheses which have been proposed but a brief statement concerning the most important groups among them. He distinguishes two classes, Cosmic and Telluric, with three subdivisions for the first: Universal, Solar and Telluro-Cosmic; and five for the second: Dislocation of the Poles, Atmospheric, Intra-Telluric, Actologic and Orographic. Although discussions and opinions are to be found under each of these headings, his main contribution appears in crystallized but abbreviated form in his conclusion, thus:

> Among numerous theories explaining the changes in climate of the earth, those should be given preference which are based upon the hypothesis that the factors which are of importance to-day in determining climate have always been effective. . . . Most importance is attached to Ramsay's theory which emphasizes most strongly the direct and indirect action of the mountains. Besides these orogenetic forces other elements, as enumerated below, probably aided in the generation of the ice ages.
>
> 1. The rise of extensive mountains (Ramsay).
> 2. The formation of ocean basins (Arldt).
> 3. The sinking of the entire ocean floor and the

[1] Theodore Arldt, "Die Ursachen der Klimaschwankungen der Vorzeit, besonders der Eiszeiten," *Zeitschrift für Gletscherkunde*, Band XI., s. 1–27, 1918.

corresponding elevation of continents (Arldt and Enquist).

4. Intensive volcanic activity with accompanying soot clouds (Sarasin).
5. Slight eccentricity of the earth's orbit (Hildebrandt).
6. Passing of the solar system through regions of the universe in which there were no stars (Noelke).
7. Decreased heat radiation of the sun (Philippi).
8. Lesser inclinations of the ecliptic (Eckholm).
9. Decrease of carbon dioxide content in the air (Chamberlain and Salisbury).

Accessory.

10. Distribution of land and sea according to Kerner's view.

Pliothermal or warm interglacial periods occurred under the following circumstances:

1. Chiefly as a result of low flat continents,
2. Through absence of deep basins,
3. Rising of sea floor and depression of continents,
4. Volcanic inactivity,
5. Great eccentricity of the earth's orbit,
6. Passing of the solar system through regions of the universe abounding in stars,
7. Great radiation of heat from the sun,
8. Great inclination of the ecliptic,
9. Increase of the carbon dioxide content of the air.

It is utterly improbable that the interior of the earth contributed to the climatic changes. Polar dislocations are also out of the question, so long as we can not prove that they followed any particular direction. All attempts, likewise, at explaining change in climate from one cause alone are futile. Although at first sight these theories may appear attractive, they can not stand the test of keener criticism. Moreover, nature is too complex to permit its being compressed into a single formula.

Chester A. Reeds

American Museum of Natural History

SPECIAL ARTICLES

OBSERVATIONS ON THE ACCUMULATION OF CARBON DIOXIDE FROM STRAWBERRIES IN REFRIGERATOR CARS

During the years 1918 and 1919 and in connection with shipping tests of strawberries in refrigerator cars being made under the direction of Mr. H. J. Ramsay and Mr. V. W. Ridley then of the Bureau of Markets, the writer was able to make observations on the carbon dioxide and oxygen content of the air in refrigerator cars and the effect of ventilation on the accumulation of carbon dioxide. A brief summary of the results follows:

The percentage of carbon dioxide and of oxygen was determined by means of a commercial Orasatt apparatus—samples being drawn through lead tubing one end of which was placed in the part of the car from which it was desired to take samples and the other run out at one corner of the door. During transit analyses were made at icing stations and at other times when the train stopped long enough. Duplicate analyses were made when time permitted, and in all cases several hundred cubic centimeters were thrown away before the sample was drawn for analysis.

The results of the analyses made during three of these tests are summarized in Table I. In the tests of 1918 the berries were loaded at a temperature of about 68° to 70° F. and one car was ventilated by raising the hatches at diagonal corners of the car. The berries loaded in the test of 1919 were at a temperature of 76°–78° F., one car being ventilated by raised hatches, and the other that reported in the last column of Table I., by two six-inch pipes, installed at opposite ends of the car.

From the table it is apparent that there is no great accumulation of carbon dioxide in the air of the unventilated cars in transit. The maximum amount 2.5 per cent., was reached in a car loaded at Monett, Mo., seven hours after the doors were closed. When the car was re-iced the carbon dioxide content dropped to 0.7 per cent. From this it increased again to 1.3 per cent., but at the next icing it dropped to 0.6 per cent. and never exceeded this amount during the remainder of the trip.

The accumulation of carbon dioxide in unventilated refrigerator cars loaded with strawberries has been found not to exceed 2.5 per

cent. by volume and is usually less. Moreover, when the cars are re-iced the air in the cars is renewed to some extent and the accumulated carbon dioxide largely swept away. In ventilated refrigerator cars the percentage of carbon dioxide is lower. It may, while the

TABLE I

Accumulated Carbon Dioxide, Expressed in per cent. by Volume, in Refrigerator Cars Loaded with Strawberries

Approximate Number of Hours After Loading	Shipment Monett, Mo., to St. Paul, Minn., 1918		Shipment Bowling Green, Ky., to Pittsburgh, Pa., 1919		Shipment Bowling Green, Ky., to Pittsburgh, Pa., 1919	
	Unventilated	Ventilated	Unventilated	Ventilated	Unventilated	Ventilated
1	1.6	—	1.0	0.7	0.7	0.2
2	—	0.2	1.1	1.0	1.0	—
3	—	0.2	1.3	—	—	—
4	1.8	—	1.4	1.4	—	—
5	—	—	—	—	—	0.3
8	2.5 0.7[1]	—	—	—	—	—
9	—	—	—	—	1.4	—
11	—	—	0,4[1]	0.4[1]	—	—
19	1.3 0.6[1]	0.6	0.3	0,2	0.3[2]	—
30	—	—	—	—	0.4	0.4
34 (also) 47	—	—	0.3	0.2	—	—

cars are standing after being loaded, become nearly or quite as great as in unventilated cars. When the cars are moved it drops to 0.2–0.4 per cent. and rarely exceeds that amount.

The accumulation of carbon dioxide in unventiated refrigerator cars is apparently not sufficient, with strawberries, to cause injury to the berries.

H. F. Bergman

Bureau of Plant Industry,
Washington, D. C.

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

The preparation and analysis of a cattle food consisting of hydrolyzed sawdust: E. C. Sherrard and G. W. Blanco. Investigations carried out at the Forest Products Laboratory indicate that a cattle food can be prepared from eastern white pine sawdust and that it has considerable food value. The cattle food was prepared by digesting the sawdust for 15 to 20 minutes with 1.8 per cent. sulphuric acid at a steam pressure of about 120 pounds per square inch. After cooking the sugars were extracted with water and the acid removed from the solution by means of lime. The liquor containing the sugar was evaporated to a thick syrup and mixed with the digested residue which had been previously dried. The whole was then dried to a moisture content of 15 per cent. It is shown that when the product has a greater moisture content than 15 per cent. the keeping qualities are not good. Leaching experiments removed all but 2.04 per cent. of the total acid and all but 7.16 per cent. of the total sugar. A comparative analysis of the wood before and after conversion shows that cold water soluble, hot water soluble and NaOH soluble substances are greatly increased but the ether soluble substances are almost unchanged by the treatment. The pentoses are reduced 46.4 per cent. while the methyl pentosans are not affected. The total cellulose is reduced by 21.68 per cent. The sugars produced correspond to 71.5 per cent. of the cellulose removed by the digestion. The lignin content is unchanged. The crude fiber corresponds to about 75 per cent. of that in the original wood. The cellulose is greatly altered by the treatment. Practically the whole of the cellulose obtained is soluble in 17.5 per cent. alkali. It is reprecipitated from the alkaline solution by dilution with water. After filtering no precipitation of beta-cellulose is obtained upon acidification with strong acetic acid.

A comparison of wood cellulose and cotton cellulose: S. A. Mahood and D. E. Cable. Samples of wood cellulose and cotton cellulose which had been subjected to various conditions of cooking and bleaching were analyzed by determining a number of constants on them, including ash, moisture, alkali solubility, pentosan and methyl pentosan content, methyoxy content, ether extract, cellulose, lignin and "copper number"; for the purpose (1) of following the changes which take place in wood cellulose on successive cooking and bleaching treatment with a view to increasing the yields of purified cellulose by varying these conditions and (2) to determine so far as possible the points of similarity or difference of cellulose from wood and

[1] Immediately after re-icing.

[2] Car re-iced seven hours previous.

that from cotton. The data show that wood cellulose most nearly corresponding to cotton, taking munition linters as a standard, is obtained by recooking "easy bleaching" sulphite pulp with soda and bleaching with two per cent. of bleaching powder. The practise of checking wood cellulose according to the specifications for cotton is a questionable procedure.

Supply and preparation of wood for the manufacture of pulp: HUGH P. BAKER.

Parchmentizing paper and the reaction of mordants: J. E. MINOR. The work of Schwalbe and Becker recently published confirms theories of the author as to the reactions which occur on the decomposition of cellulose during beating. The hydrolysis of cellulose forms dextrines which are mucilaginous, soluble in water and easily reduce Fehling solution. These dextrines are readily adsorbed by pure cellulose thus constituting the reactive, insoluble, colloidal hydrocellulose, and in this position they catalyze further cellulose hydrolysis. Complete hydrolysis leaves only soluble dextrines or sugars. For a mucilaginous accumulation as is desired for making parchment paper, the velocity of the initial reaction must be catalyzed, either by the hemi-celluloses of wood incrustation, or by acid treatment of pulp prior to beating. Acid treatment of pulp reduces the time required to beat to mucilage to one half or one tenth the original amount required, and increases the strength of the paper made from it. Pulp mucilage has a greater power of splitting salts and adsorbing metal ions than has cellulose and, therefore, assists in holding size, dye, coating, etc. Metal impregnation weakens paper strength.

Is it feasible to form a section of cellulose chemistry? G. J. ESSELEN, JR.

Solvents for phosgene: CHARLES BASKERVILLE. An impelling factor in causing the Germans to sign the Armistice was a knowledge of the rapid development of the stupendous poison gas program of the United States. One of the earliest gases, a real gas, used by the Germans, was phosgene. It had been manufactured on a small scale in Germany before the war. Small amounts were exported to the United States prior to 1914. It was being produced in this country for similar uses after the blockade had shut off the importation of chemicals in the manufacture of which the Germans had made a specialty. It was transported in small quantities liquefied in cylinders. When hostilities ceased we were producing the poison gas for war purposes at the rate of fifty tons a day, with a program nearly completed for a much larger production. Soon after the Armistice was signed restrictions were imposed which prevented railroad transportation of phosgene liquefied in cylinders. Uses for war gases in peace times have been sought. The author has found several solvents for the gaseous phosgene, among them gasoline, benzine and ethyl acetate, which dissolve an equal weight of the poison gas at ordinary temperatures. The solutions exert practically no pressure beyond atmospheric, so may be transported with safety within ordinary closed containers. On exposure to the air the liquid and dissolved gas evaporate. The solutions offer simple means for the use of a poison gas to exterminate rats and moles. On warming the solutions in suitable vessels the phosgene is liberated and may be used in a pure form in the manufacture of certain coal tar products of color or medicinal value.

An electrometric method for detecting segregation of dissolved impurities in steel: E. G. MAHIN and R. E. BREWER. Previous work has shown that both non-metallic and metallic inclusions cause carbon segregation in steel and the hypothesis has been advanced that this is due to the steel acting to some extent as a solvent for the foreign material. If this is correct the electrode potential of the metal should be altered in the regions immediately surrounding the inclusion. It is not possible to determine this point by the usual method involving immersion of the specimen in an electrolyte but a method has been devised for exposing microscopic areas of metal surface to an electrolyte, so that the micro-electrode thus formed may be connected with a standard calomel half-element and the E.M.F. of the system measured by the usual compensation method. This method has been applied to an investigation of the ferrite bands produced by heating steel in contact with metallic inclusions; it has been found possible thus to measure the potential of these micro-areas and to establish the fact that the ferrite of these segregated portions possesses a distinctly lower potential than the ferrite of the body of the steel. The work is being extended to include investigation of the potential of ferrite adjoining other metallic and non-metallic inclusions and it may be applied also to the detection of segregation of the constituents of non-ferrous alloys.

Soda-lime for industrial purposes: R. E. WILSON. The work to be described in this paper was an

outgrowth of work done in the Chemical Warfare Service to develop soda-lime for military purposes. Soda-lime for industrial purposes, however, must have much greater activity and capacity and, on the other hand, need not be so hard and need not contain an active oxidizing agent, both of which requirements seriously limited the efficiency of the soda-lime used for military purposes. The paper describes extensive experiments designed to determine the best method of manufacturing soda-lime in order to get maximum activity and capacity against the different gases. The factors determining the brand of lime to use and the best percentage of caustic soda and water were found to be the most important variables after the basic method of manufacture was decided upon. Slides will be shown to indicate the effect of each of these variables on the efficiency of the resulting product against CO_2, SO_2, phosgene, chlorine, superpalite and hardness. The final formula developed as the result of these experiments has been used with great success for a variety of commercial purposes and has been found to be many times as efficient as any of the commercial grades now on the market which are made by radically different processes and contain much more alkali.

Flow of viscous liquids through pipes: Robt. E. Wilson and M. Seltzer.

New solvents for rosin extraction: H. K. Benson and A. L. Bennett. The use of Douglas fir as a source of rosin and turpentine is discussed and the method of tapping the forest trees now in use to a limited extent is described. Attention is called to the very large quantities of resinous mill waste which could be made available for rosin production under proper organization. Realizing that rosin extraction has been under a heavy handicap due to the retention of the solvents by the wood to an extent of as high as 25 gallons per cord in some commercial plants, a search for more easily recoverable solvents was undertaken. Among those that lend themselves to rosin extraction are 5 per cent. ammonium hydroxide and 70 per cent. denatured alcohol solutions. Analytical data are presented on the effect of time and size of wood, on the efficiency of extraction, the decomposition of the ammonia extract, the separation of humus from rosin and the recovery of ammonia from the wood by steam distillation. The following conclusions are presented: (1) When resinous wood of pulp size is treated with 8 times its weight of 5 per cent. ammonium hydroxide for 10 hours 94.5 per cent. of the rosin is extracted. (2) The ammonia extract decomposes slowly in the air at ordinary temperatures and at 90°–100° C. is rapidly and completely decomposed yielding ammonia vapor and finely divided rosin and humus in suspension. (3) Humus does not retain more than 1.7 per cent. of petroleum ether upon heating at 100° C. for thirty minutes. (4) Wood chips saturated with ammonia solution give off the ammonia completely when steam distilled. (5) Denatured ethyl alcohol at a dilution of 70 per cent. is as efficient a solvent for rosin as ammonia, benzene, turpentine or petroleum ether.

Comparative study of vibration absorbers: H. C. Howard. A simple instrument for obtaining records of horizontal and vertical vibration in buildings was constructed. Comparative measurements of the vibration absorbing capacities of various materials and devices, such as cork, felt, rubber air-bags, rubber balls and suspensions were made. Certain arrangements of rubber balls were found to be very effective.

Note on catalysis in the manufacture of ether: Hugo Schlatter. Senderens' experiments (*Comptes Rendus*, Volume 151, page 392) on the action of aluminum sulphate in the manufacture of ether were repeated in glass apparatus and confirmed. When the same experiments were carried out in a small ether still constructed of lead, no difference in production was observed between the usual method of procedure and the process in presence of aluminum sulphate. The author's conclusions are against Senderens' theory of the formation of a double salt, inasmuch as not only lead sulphate, which is normally present in the lead stills used in factory practise, but broken porcelain also gives the same results as aluminum sulphate.

Charles L. Parsons,
Secretary

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THE FUTURE OF AGRICULTURAL SCIENCE IN THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

It is certainly within the recollection of the youngest member of Section O that the attachment of the designation *Agricultural* at once removed the matter under discussion from the scientific field. Agricultural botany, agricultural physics, agricultural chemistry, and the other agriculturals were simply the reflections of the glories of the pure sciences into the dark, unfathomed caves of everyday living. No real botanist would study the corn plant. No real chemist would waste his time on its chemical composition. The physics of the soil was certainly beneath the physicist. Such lights in the darkness as Darwin, Liebig and Pasteur (whose great work was done with domesticated plants and animals, soils and industries agricultural in the broad sense) failed to sensitize the blind spots in the minds of the pure scientists of yesterday. To-day this situation no longer exists, not so much because of any change in the sciences themselves, but more because of the sensitization of the blind spots in the minds of those who devote themselves to scientific study.

This change has come about largely as the result of the work of the agricultural experiment stations. It is true that in the beginning much was done by workers in the stations in the name of science that was not scientific, but that has always been true, even more in the history of so-called pure science than in this period of the beginning of agricultural science. It is generally true to-day. In the beginnings of agricultural science,

[1] Abstract of the address of the vice-president and chairman of Section O, Agriculture, American Association for the Advancement of Science, Chicago, 1920.

speaking generally, the workers of necessity came from the so-called pure science field. While they doubtless lost caste for a time, many of them have lived to see the old opposition die. The best universities in the land are now proud to call these men from the agricultural experiment stations to their highest research positions.

The worker in the land grant college, the experiment station or the National Department of Agriculture, as in other fields, is now accepted on his merits as a research worker. Research in the field of agriculture has, as in the days of Darwin, been so fruitful in results of scientific as well as economic value that it is receiving the attention of such institutions as Harvard, Yale, Columbia, Johns Hopkins and Chicago, as well as of the great state universities, and most recently by the Rockefeller Foundation for Medical Research in its laboratories for animal diseases under the direction of Dr. Theobald Smith, formerly in the Bureau of Animal Industry, of the U. S. Department of Agriculture, and later in the Bussey Institution of Harvard University. This Foundation also contemplates a similar laboratory for phytopathological research.

The latest development in this field is the organization of the Division of Biology and Agriculture of the National Research Council, an agency established by the National Academy of Sciences at the request of the President of the United States, to organize and conduct research in every field necessary during the world war. After the close of the war the President requested that the Council be reorganized for the promotion of research of value to the nation and placed on a permanent basis. This was carried out in a comprehensive way, supplementing existing agencies, governmental and private, without supplanting them; in fact, the National Research Council is now a clearing house of research agencies of the United States, also having relations with similar organizations abroad through an international association. It supplements the work of the American Association for the Advancement of Science, and through stimulating research in general it will, without doubt, increase the interest of scientific workers in this association, which is the greatest organized scientific forum of the United States. Every live scientific worker in America should join this association through the sections in which he is especially interested. Section O should be the largest and livest Section of the Association. We draw from all sciences and are interested in all, including those usually designated as social and economic. We may be members also of special affiliated societies, like the Botanical Society of America, the Society for the Promotion of Agricultural Science, etc., but that is all the greater reason why we should be members of Section O—the agricultural focus of this association.

It has been proposed to merge the famous old Society for the Promotion of Agricultural Science with Section O. I believe that this is a wise move. Possibly the same idea could be carried out with reference to some other societies in relation to other Sections. We need but two types of society organization based on subject matter—one small, select, highly specialized group and one generalized group. There are now too many organizations covering practically the same field. Time and money are not available to keep in touch with all. Let us carefully study the problem and consolidate wherever it can be done to advantage. All of the great research organizations ought to be affiliated with the American Association for the Advancement of Science and hold their meetings at the same place in such way as not to conflict with each other. This has been accomplished in part. It should now be completed.

While much has been accomplished in agricultural investigation in the past we are just entering what may rightly be termed the scientific phase of agricultural development. Research in this field must be greatly intensified. The mere mention of some of the fields such as genetics, plant and animal nutrition, plant and animal disease, disease resistance and immunity, and soil biology will recall to your minds at once the fact that we are just

at the beginning. If we are to feed and clothe the increasing population of the world and still retain some time for culture and recreation we shall need to conduct scientific research in all fields to an extent hitherto unheard of. This is especially true in the fields represented by this section. Unless we succeed in furnishing food and clothing nothing else avails. Except for temporary displacements, due to faulty distribution, population increase has been more rapid than food production. The time is at hand when we should have scientific information regarding disease control, genetics, maintenance of fertility and cultural methods which we do not now possess. It may take years of patient study to get it. We must educate the public to understand the need and provide for it. It is a part of the duty of this association to take part in this educational work. It is the special duty of this section in regard to agricultural science. Let us be a federation of inspiring spirits as well as active workers for its promotion.

A. F. Woods

University of Maryland

INVESTIGATION OF THE FLORA OF NORTHERN SOUTH AMERICA[1]

In the summer of 1918, after consultation and correspondence by members of the staffs of the New York Botanical Garden, the United States National Museum and the Gray Herbarium of Harvard University, a cooperative investigation of the botany and plant products of northern South America was organized and has since been prosecuted. It is planned to include geographically the Guianas, Venezuela, Colombia, Ecuador, and the adjacent Caribbean islands Trinidad, Tobago, Margarita, Bonaire, Curaçao and Aruba.[2]

The reasons for the investigation are the deficiency of exact information relative to the vegetation of the region and the paucity of specimens of plants inhabiting it in museums and herbaria of the United States. By far the larger representation of the species is in European institutions. A great number of them have been collected only once, and records of habit and habitat are either altogether lacking or quite inadequate. Owing to the necessity of making comparisons of specimens with the types preserved in the European collections, much of the material which has hitherto found its way into American institutions has remained incompletely determined. While the published literature of the subject is large, it is widely scattered, and there are no complete lists of plants or descriptive floras of any part of the area under investigation; such monographs or lists of species of genera or of families as have been attempted by authors are incomplete and very many species have been erroneously identified. As to plant products, we are as yet uninformed in many cases as to the identity of the species of plants yielding them and whether or not the supply of such products can be increased by the cultivation of the species from which they are derived.

The investigation is making progress in remedying these conditions, through the study of series of specimens recently obtained in Dutch Guiana, British Guiana, Trinidad, Tobago, Venezuela, Curaçao, Colombia and Ecuador, collectively providing specimens representing several thousand species, and further field expeditions are being arranged. The collections when received, are divided among the three cooperating institutions, field agents being instructed to obtain three specimens of each plant collected whenever possible, and also to make record of habit, habitat and color of flowers and fruits and to make other notes which may be of importance. Specimens beyond three in number may be sent to other institutions or to specialists, and the cooperation of many experts has been obtained.

Preliminary studies of the collections already made prove that the investigation is very well worth while. Dr. Francis W. Pennell, of the New York Botanical Garden staff, expert in the Family Scrophulariaceæ, has detected and partly described some 70 species

[1] Read at the Princeton meeting of the National Academy of Sciences.

[2] See Science, 48: 156, 157, 1918.

new to Science from his own collections made in Colombia and in those made in Ecuador by Dr. J. N. Rose. These collections have yielded to Dr. B. L. Robinson, of the Gray Herbarium, expert in the genus *Eupatorium*, some 20 undescribed species, and to Dr. J. M. Greenman, of the Missouri Botanical Garden, expert in *Senecio*, about a dozen. Many grasses new to science were collected by Dr. A. S. Hitchcock, Agrostologist of the United States Department of Agriculture, in Venezuela, British Guiana, Trinidad and Tobago, and those obtained by other collectors have been classified by him. Much important information about the Cacti and some 10 new species were obtained by Dr. J. N. Rose, in Venezuela and in Ecuador. Dr. S. F. Blake, of the Bureau of Plant Industry, has done much work on the Carduaceæ.

Mr. W. R. Maxon, of the United States National Museum, is engaged in identifying the Ferns and Fern Allies, Mrs. Britton, at the New York Botanical Garden, is studying the Mosses, and Professor Alexander W. Evans, of Yale University, the Hepatics. Dr. W. A. Murrill and Dr. Fred. J. Seaver, of the New York Botanical Garden, and Dr. J. C. Arthur, at Purdue University, have partially identified the Fungi collected. Several other students are investigating smaller groups.

Much desultory work in identifying plants incidental in various families has been accomplished by Dr. J. N. Rose, by Dr. B. L. Robinson and by me. In order to make comparisons with types and authentically named specimens, I took this summer several hundred recently collected specimens of several families to the Royal Botanical Gardens at Kew, England, and compared them with the great collection preserved in the herbarium there; the wealth of undescribed species in the region under study is well illustrated by the fact that I was able to match only a small proportion of them.

In order to obtain a view of the vegetation and to increase the collections, I spent March and April in Trinidad, the part of the region perhaps the best known botanically, but even there I was able to add some fifty species to the known flora of that island, some of them new to science, through specimens collected by myself and members of my party and by studying the fine herbarium of the Botanical Garden at Port of Spain.

The field work has mostly to be done by collectors sent from the north, but we have highly valued cooperation from Mr. W. G. Freeman, Director of Agriculture of Trinidad and Tobago, and Mr. W. E. Broadway and others of his staff; Mr. Henri Pittier, Agricultural Expert of the Venezuelan government, is sending material from that republic; when Dr. Pennell was in Bogota, Colombia, he secured the cordial cooperation of the Christian brothers there, who are forming a Natural History Museum, and when Dr. Rose was in Ecuador he secured the interest of Mr. A. Pachano; we are also assured of cooperation through the governments of French Guiana, Dutch Guiana and British Guiana.

The investigation is also adding much to the knowledge of the natural geographic distribution of species, especially as regards those ranging into Panama and the West Indies.

It is becoming increasingly evident that we should obtain as much exact information as possible concerning the vegetation of tropical and subtropical America.

N. L. Britton

New York Botanical Garden

PRACTICAL PSYCHOLOGY[1]

It is not easy to find an adjective describing adequately the applied psychology of tomorrow. "Solvent psychology," even apart from the alliteration, makes a certain appeal, for it designates a science capable of meeting all obligations; but the word has implications of deductive solutions reminiscent of metaphysics, Christian Science, psychical research, psycho-analysis, and other mysteries. William James, our distinguished master, has given

[1] An address before the Section of Psychology at the Chicago meeting of the American Association for the Advancement of Science, December 29, 1920.

such currency to pragmatism in philosophy that the word might be carried over into psychology. The dictionary, however, defines "pragmatic" as "officious, occupied with trifles"; so perhaps the word should be reserved for philosophy. "Practical," of the same origin as pragmatic, also illustrates the tendency of the meanings of words to deteriorate that throws a curious light on human nature. For as those who can do things have come to be called cunning, crafty, scheming, artful and designing, so those who continue to do things are looked at somewhat askance; when a famous letter used the phrase "you and I are practical men," the reference was not understood to be to perseverance in good works. However, we must do the best we can with a language imposed upon us when we were helpless infants; in so far as practical psychology means psychology based on the facts of experience, applied to useful ends and earning the means for its support and advance, it defines the kind of psychology that I wish to advocate.

It is no longer necessary to argue that psychology is a science resting upon experiment and measurement, that it is primarily concerned with individual differences in behavior, that it can and should be applied to promote human welfare. Psychology is much more concerned with what people do than with what philosophers think they think. Yet I look back to a time when I was in a minority—almost a minority of one—in urging these things. We are perhaps now no less dogmatic than our former opponents; as they once told us that the things in which we were interested were not psychology, so we to-day are likely to excommunicate from our fellowship any who hold that psychology consists of introspections of philosophers that are universally true but have nothing more to do with conduct than theology has to do with the control of the Being whose attributes it describes.

But those of us who believe in applied psychology still have to face and solve the problem of applying psychology to secure the support and advancement of psychology, and this from the standpoint of practical psychology is equivalent to the support and advancement of psychologists; for we obviously are the *veræ causæ* of psychological research. Progress there certainly has been. We are no longer little sisters in the house of philosophy. We supply an eligible list for every vacant presidency of a university or endowed corporation. We are paid about the same salaries and have about as many students, summer courses, extension courses and correspondence courses as our colleagues. In innumerable faculty and committee meetings we share their polyphasia and their apraxia. We also are permitted to devote our leisure time to research.

Psychologists are in somewhat the same situation as students of other subjects; but there are several distinctions. Having recently arrived and belonging to the comparatively *nouveaux riches,* we are self-conscious beyond the average; and as we propose to concern ourselves with the control of conduct we can be professionally occupied with the conditions under which we work, while in this regard others are only amateurs. If we can select college freshmen and telephone girls, we should begin at home and be experts in selecting psychologists for the laboratory; if we can determine the conditions under which factory hands work to the best advantage, we should be able to learn how psychological research can be accomplished most effectively; if we can describe and direct the complicated behavior of infants and children, we should be able to understand and control the simpler and more naïve official reactions of university presidents and trustees.

It is further the case that professional psychologists are at the present time a group so small that they can cooperate in a way impossible for the hundred and fifty thousand physicians or engineers of the country. The members of the American Psychological Association number 393, and there are not so many competent American psychologists, for the association does not undertake to exercise a censorship over the standards of its members. All American psychologists can get together in a room and each can be personally ac-

quainted with all. There are probably as many psychologists in the United States as in the rest of the world. The responsibility of each of us is large.

Why should we not unite to take over the psychological work of the country and conduct it in the interest of psychology? The railway men and the coal miners propose to manage the railways and the mines; but these are difficult undertakings, owing to the vast number of men and the immense properties that are involved. At present corporations, trade unions and other associations of individuals and interests are more potent forces in the social order than congresses or legislatures. Being unfortunately interested in the cost of printing, I have some information on that subject. The working printers by efficiently organized unions have been able to increase their wages beyond those of professors. The employing printers have in turn organized a United Typothetæ do deal with the compositors and the pressmen and more especially with the publishers and the public, which latter they have done effectively by increasing costs more than 100 per cent. Now a publishers association has been organized and there is also a writers union. It is the poor ultimate consumers who must take what is handed to them, though they too are beginning to cooperate.

As teachers or salaried experts psychologists are employees, but very few scientific men are employed primarily to undertake research. There is no reason why college and university teachers should not unite, as public school teachers are now doing, to increase their salaries, to secure permanence of tenure or to improve the conditions under which they work. Perhaps the first step in this direction taken by a scientific society was a resolution proposed by me and passed at the meeting of the American Psychological Association in 1912 to the effect that it is inadvisable for members to give summer or extension courses at a lower rate than their regular salaries. The association has also joined with the American Philosophical Association in a protest against dismissing a member from a college on account of the doctrines that he taught, and just now it is defining the qualifications for psychological experts. The American Association of University Professors has been expressly organized to safeguard academic freedom and the rights of teachers in so far as that can be accomplished by committee reports.

But such halting steps carry us only a short way. In our psychological research work we are not as a rule employees, but capitalists to the extent of the ability that we have. It is almost the only capital that can be used in this way; its earnings represent an enormous usury that accrues not to the individual but to society. This should be its ultimate destination; but if the capital is not increased and used to the best advantage, then all suffer. Research in any science is worth manyfold its cost; if an organized democracy can learn this fact and act accordingly the problem is solved. In the meanwhile it is our business to see that we reserve for research part of what we earn and use it to increase our working capital, namely, the number of competent psychologists and their opportunities to advance psychology and to apply it in useful ways.

Research and practise in psychology are not essentially different from research and practise in other subjects, except in so far as the inventions of the psychologist are not protected by the patent office. Dr. F. G. Cottrell has devised an admirable benefaction—if benefactions are ever admirable—by presenting to a corporation valuable patents, the proceeds to be used for other researches. But in general men earn their livings by teaching or applying science and advance it only as a sport. An expert and popular surgeon can earn $50,000 a year by cutting out appendices, but if he should by prolonged research discover a cure for appendicitis, he would be paid only in the fiat currency of honorary degrees or the like and would lose his practise. A professor of psychology can with the utmost difficulty increase his salary by his published researches; he can do so readily by becoming one of the house carls of the president.

Apart from using research as a kind of lottery in which men may draw better uni-

versity positions and hold them without further effort, so long as they observe all the proprieties of their social caste, the rewards and opportunities for carrying on research as a profession are few. The government does something; but it has scarcely discovered psychology, and its methods seem devised for the suppression of originality. Several foundations, munificently endowed from the proceeds of monopoly and a protective tariff, are providing for excellent research work; we may hope that psychology will some day share the spoils in case they do not involve any explicit or implicit controls. The research laboratories of the industrial corporations are the most promising development of recent years. There are more of these than there are university laboratories of physics and chemistry, and they probably already surpass academic work in quantity and quality, not only in applied science, but also in science not obviously or immediately useful. In this direction the Scott Company has made a beginning auspicious for psychology.

But as a rule scientific men are employees with a tendency to belong to the class of domestic servants rather than to the artisans with well organized unions. For not only are our wages fixed by the favor of superior officials, but we are expected to exhibit the virtues of the domestic servant and to submit to similar regulations as to wash days, days off, liveries, sweethearts, respectful speech and the rest. This situation obtains wherever scientific men are employed—in the government service, in universities, in research foundations, in industrial laboratories—though these seem to represent a series of increasing salaries and decreasing restrictions.

It need not be considered here whether it is in the interest of science and of society for teachers or employed experts to form unions; but it may be remarked that a point in their favor is the fact that teachers are now being dismissed because they belong to them. My argument is that while as teachers, administrative officials and institutional experts we are employees, as psychologists we are capitalists to the extent of our ability, originality and energy. We should form associations to employ our brains in the most useful and profitable ways.

Lord Kelvin was a university professor, an electrical engineer and a mathematical physicist. As a teacher he received a modest salary, as an inventor and expert he made a large fortune, as a scientific man his reward was to be president of the Royal Society and to lose his good name as William Thomson. For the latter circumstance, however, his money and his lack of an heir were largely responsible; Faraday did not become even a Sir. Kelvin was paid inversely as the value of his diverse services; but he could be comfortable as a teacher and command time, assistance and equipment for research through the means that he earned as an engineer. It is also the case that, if his teaching had been confined to research students, the three lines of his work would have been reciprocally helpful.

None of us is a Kelvin, but collectively we do work more important in teaching, in the applications of science and in research. Many individuals try to do the three things, but we do not have either the genius or the opportunity that Kelvin had. Correspondence courses, elementary text-books, pot-boilers, even the administration of routine tests, are not conducive to research, and may result in a sweat-shop system by which regular salaries are reduced below the living wage. But it would be posible for us to unite to use our resources for the common benefit of society, of psychology and of ourselves. The wage fund for teachers and experts is not fixed by unrepealable economic laws, but could be doubled by proper efforts. If one tenth of the economic by-products of research could be reserved for the workers, and a second tenth for the support of further research, if one tenth of the economic value of the applications of psychology could be paid to the psychologist who does the work and a second tenth be devoted to new investigations, then psychological research would be supported to an extent hitherto undreamed of in the his-

tory of science, and still society would receive eight tenths of our services as a free gift.

The tests of individual differences devised by a few psychologists in the course of the past thirty years have been dramatically exploited by the tragedy of war. These measurements of general intelligence and special aptitudes are interwoven with the whole fabric of the mantle of science, but the direct work of consequence involved in their development was done by a score of us in the intervals between the hours of our employment. When a committee was formed to adjust these tests to the needs of the army not even our traveling expenses were paid. An officer high in the army has estimated at a billion dollars the value of the gift gladly made to the nation; it would indeed have been so much if the war had been long continued. At a cost of about fifty cents each, tests were made on nearly two million recruits, and the value of each for purposes of promotion, elimination and selection appears to have been somewhere between ten and one hundred dollars. The economic value of such tests for school systems, for the government service, for industries, in all cases where individuals are selected for work, for promotion or for special tasks, is equally great.

By psychological tests made in an hour and at a nominal cost, we may tell better to what classes children should be assigned in school than can the teachers who have taught them for months. We may tell better from such tests whether a boy is fit for college or for a scholarship there than from a mnemonic examination in preparation for which years of his life have in large part been misspent. We may select recruits for promotion or for special assignments in the army more accurately than can their superior officers. We may determine the fitness of clerks, telephone girls and many other groups better than can their employers. With increased knowledge such as can be gained from further research, we may be able to double the productivity of labor by selecting individuals for the work for which they are best fit, all the way from the moron to the president of the nation. That would mean an annual increase in wealth of seventy billion dollars a year for this country, of five times as much for the world.

The productivity of labor can probably again be doubled by such improvements in the environment as it is within our power to make. This is largely the province of the material sciences, but the reactions of the human machine are of immense importance. There are innumerable problems awaiting investigation and solution. Such are: the desirable hours of labor; the most efficient movements; interest, enthusiasm and imitation; all conditions favorable or unfavorable to work or other forms of activity, including ventilation, heating and lighting; food, alcohol, coffee and tobacco; rest, play and sleep; posture and strain in employments, conditions of fatigue and safety, wherever the central nervous system, the neuro-muscular mechanism and the senses are concerned.

I am less sanguine in regard to our power to alter the constitution of individuals, but we can at least safeguard psychology from false claims, and it may be that the child and even the adult may prove plastic under the right conditions. The savage could not imagine turning iron into steel, still less turning steel into a cantilever bridge. Schools, churches, the press, the family, customs, laws, governments, are indeed all means to control and direct behavior. Their success in altering individuals has been but modest, and it is by no means certain that psychology as a science can accomplish much more than the Book of Proverbs to improve the situation. Perhaps it can do something, especially in the way of the elimination of futile and harmful methods, and a generation of research by a thousand able men might contribute results of immense value, measured either economically or in terms of human welfare. At present, however, and perhaps always, we can do more to alter the environment and to place individuals in situations where their reactions are what we want than we can to alter individuals. Fortunately all men are not born equal; it is both undesirable and impossible to make them equal, or indeed to alter fundamentally the

constitution with which they are born. But we can give them equality of opportunity and more; for we can provide the best opportunity for each and improve the environment for all. Even though it may be difficult to alter people after they are born, it may ultimately be possible to select the kind of people that we want to be born.

"The harvest truly is plenteous, but the laborers are few." And this is in large measure because we limit ourselves to the solution of St. Matthew: "Pray ye therefore the Lord of the harvest, that he will send forth laborers into his harvest." We do not use tested business policies to organize our work, but wait for the lords of the harvest to find us and to care for us.

> The fault, dear Brutus, is not in our stars,
> But in ourselves, that we are underlings,

or, in modern terminology, it is not the situation, but our failure to apply scientific methods to our own work, that makes us a feeble group gathered in Chicago when we might be a dominant force throughout the world. We should be practical men and see to it that we have a practical psychology.

J. McKeen Cattell

JOHN NELSON STOCKWELL

John Nelson Stockwell, mathematician and astronomer, was born in Northampton, Massachusetts, April 10, 1832. When he was a little more than a year old his parents moved to Ohio, and at eight years of age he went to live with an uncle and aunt on a farm in Brecksville, not far from Cleveland. In speaking of his early education, he says he took very little interest in his studies until just before the outbreak of the Mexican War, when he became interested in history and, at the same time, began to solve arithmetical problems published in a weekly Philadelphia paper which found its way to Brecksville. It soon appeared that he could solve these problems readily and for a number of years he sent the answers to the paper week after week; he also worked every arithmetical problem he could find in old arithmetics which came into his hands. Algebra was not studied in the country schools in those days, and it was not until 1849 that he was able to begin work on this subject. He could find no teacher, but the subject proved to be so easy that he did not need one.

A total eclipse of the moon which occurred in November, 1844, first called his attention to celestial phenomena. From that time he was an ardent student of old almanacs and any other works which he could acquire dealing with astronomical events. When he was seventeen years of age, he secured a text-book on practical geometry and a year later began the study of general geometry, again without a teacher. So absorbed was he in mathematics that he found the work on the farm irksome and arranged to give less time to that and more to his studies. Olmsted's "Astronomy" and Dr. Thomas Dick's works gave him much practical information, but failed to satisfy him because they did not give enough theoretical work nor did they contain the mathematics necessary to predict astronomical events. The books he read frequently spoke of "La Place" and the "Mécanique Celeste." Young Stockwell, being determined to own this work, ordered it of a bookseller in Cleveland and received it in 1852, when he was twenty years of age. He found then, to his great surprise, that it consisted of four large quarto volumes and the cost was far in excess of anything he had imagined. But his desire for the work was so great that he was perfectly willing to give a half summer's work to get the money to pay for it. Before this time he had become somewhat familiar with calculus and was, therefore, able to understand much, if not all, of the content of these volumes.

From 1849 to 1851 he devoted all of his leisure to the study of geometry, trigonometry and higher mathematics, and in 1852 published a "Western Reserve Almanac of the Year of our Lord, 1853." By a mistake of the publishers his name was omitted from the title page and few, if any, knew the author. Soon after this he became acquainted with

Dr. B. A. Gould, who had recently begun the publication of the first astronomical journal in the country devoted to research work. In 1854, through the influence of Dr. Gould, Mr. Stockwell was appointed a computer in the Longitude Department of the United States Coast Survey and moved to Cambridge, Massachusetts, in order to carry on his work under Dr. Gould's direction.

Eight months later he returned to his uncle's home in Brecksville and resumed his farm work, giving all of his spare time, as before, to mathematics and astronomy. Before 1860 he had mastered the methods of computation of the orbits of planets and comets, and had computed the orbits of two comets which appeared in 1853. He computed the orbit, the perturbations and ephemeris of Virginia, the fiftieth asteroid, for its opposition in 1859. These results were published in the *Astronomical Journal.* In 1860 he published a new method of solving a set of symmetrical equations having indeterminate coefficients. In addition to these investigations, by 1860 he had begun a very extensive and elaborate computation of the secular variations of the planetary orbits arising from mutual attractions of each other. This work was interrupted by the war, however, and was not completed until 1872, when it was published in the Smithsonian Contributions to Knowledge. In 1861 he was given the position of computer in the United States Naval Observatory and continued in this work until 1864. At that time the United States Sanitary Commission, which had collected a large quantity of statistics in regard to sanitary conditions, requested Dr. Gould to reduce and discuss them, and he in turn asked Mr. Stockwell to assist him.

One day, while in Cleveland, he was inquiring in a bookstore in regard to the non-arrival from Europe of some books on the theory of probabilities. Shortly after that the book dealer mentioned this to Leonard Case, afterwards the founder of Case School of Applied Science, who said that he would loan these books to Mr. Stockwell as he happened to have them in his library. This act led to the acquaintance and friendship between these two men which continued for many years. Through the influence of Mr. Case, Mr. Stockwell soon afterwards moved to Cleveland and lived there during the remainder of his life. Mr. Case, a graduate of Yale University and a great lover of mathematics, persuaded Mr. Stockwell to undertake a complete discussion of the mathematical theory of the moon's motion. This work was never wholly finished but many specific problems in relation to the subject were completed and published from time to time.

During 1891 and later, Mr. Stockwell pubished a series of articles in various astronomical magazines on the subject of the ancient eclipses. If the theory of the moon's motion used in such computations is correct, then the predicted time of an eclipse will agree with the historical time, but if there are errors in the theory, the computed time will evidently differ from the historical time. Mr. Stockwell was able to prove that in a large number of cases the historical times agreed very closely with the theoretical times computed by his tables, and this proved that his theory of the moon's motion was substantially correct. Nearly a hundred ancient eclipses were computed and many of the results were published.

In 1881, after the death of Mr. Case, Case School of Applied Science was opened. It was but natural that the board of trustees should invite Dr. Stockwell (he had received the degree of doctor of philosophy from Western Reserve College in 1876) to become professor of mathematics and astronomy. He continued to serve in this capacity until 1887, but his tastes were for research and not for teaching and in the latter year he resigned his professorship and through the remainder of his life, devoted himself to that science which he had cultivated for so many years.

Among the many articles contributed by him to the journals, we find that a large proportion have to do with the theory of the moon's motion or the computation of eclipses based upon such theory. There are, however, many articles upon the orbits of comets,

chronology by means of ancient eclipses, inequalities in the motions of many of the planets, the procession of the equinoxes, and the mutual perturbations of planets.

In 1919 he published a new solution of the problem of the tides. In the preface to his work he says:

The cause of the tides was sufficiently and correctly explained by Sir Isaac Newton in the year 1687; and the mathematical development of the effects produced by that cause upon the waters of the ocean has been the great unsolved problem before the scientific world for more than 230 years.

Mr. Stockwell believed that he had solved this problem, and in his recent pamphlet he gives two different solutions and a set of tables of the solar and lunar tidal waves, together with the method of computing the tides at any point on the earth's surface.

In 1855 he was married to Sarah Healy, a foster-daughter of his uncle, and they lived together for over sixty-one years until she died, at the age of eighty-three. Their life together was an ideal one. Besides taking upon herself much of the burden of domestic cares in order that her husband might devote himself more fully to his scientific work, she sympathized fully with him in all that he was doing and gave him her encouargement.

Dr. Stockwell continued his mathematical work up to within three weeks of his death. Although he lived to be eighty-eight years of age, his mind was perfectly clear, and until attacked by his last illness, he was able to carry on his work with much of the vigor which had always characterized his investigations. Occasional visits by him to my office kept me in touch with what he was doing, and I was very glad to be able to loan him, from the college library, some books which he did not possess. He was a natural mathematician and acquired his knowledge without a teacher because his clear, analytical mind was able to grasp and understand any mathematical or astronomical theory which intereted him. The long list of his published papers shows that he was also possessed of that rare type of mind—the type which can work out for itself new things in mathematics and science which clearly interpret the great laws of our universe.

CHARLES S. HOWE

SCIENTIFIC EVENTS

CHAIR OF LOGIC AT THE UNIVERSITY OF LONDON

DR. C. A. MERCIER, the distinguished London alienist, in his will offered $100,000 to London University to endow a chair under stipulations, sent us by Dr. E. E. Slosson. They are:

Scheme for the establishment of a Professorial Chair of Rational Logic and Scientific Method. The purpose of this foundation is that students may be taught, not what Aristotle or any one else thought about reasoning, but how to think clearly and reason correctly; and to form opinions on rational grounds: the better to provide that the teaching shall be of this character, and shall not degenerate into the teaching of rigid formulæ and worn out supersitions, I make the following conditions:

The professor is to be chosen for his ability to think and reason and to teach, and not for his acquaintance with books on logic, or with the opinions of logicians or philosophers. Acquaintance with the Greek and German tongues is not to be an actual disqualification for the professorship, but in case the merits of the candidates appear in other respects approximately equal, preference is to be given first to him who knows neither Greek nor German; next, to him who knows Greek but not German; next, to him who knows German but not Greek; and last of all, to a candidate who knows both Greek and German.

The professor is not to devote more than one twelfth of his course of instruction to the logic of Aristotle and the schools, nor more than one twenty-fourth to the logic of Hegel and other Germans. He is to proceed upon the principle that the only way to acquire an art is by practising it under a competent instructor. Didactic inculcation is useless by itself. He is, therefore, to exercise his pupils in thinking, reasoning and scientific method as applied to other studies that the students are pursuing concurrently, and to other topics of living interest.

Epistemology and the rational grounds of opinion are to be taught. The students are to be prac-

tised in the arts of defining, classifying and the detection of fallacies and inconsistencies.

The principle of causation is to be taught as a process occurring in nature, and applicable to material things, and not as a notion in the minds of philosophers.

Subject to these requirements, a wide discretion is to be allowed to the lecturer.

COURSE ON SCIENCE AS APPLIED TO INDUSTRY

The Sheffeld Scientific School at Yale University announces a new general course, to be given during sophomore and senior years on "Science as Applied to Industry" to be given next fall for the first time. The official pamphlet says:

The object of this course is to give students a broad training, based upon a knowledge of certain of the fundamental sciences and of scientific methods, for executive and managerial positions in the business world. The course is not designed for students seeking preparation for a professional career in some particular branch of science, such as chemistry, geology, or metallurgy, where problems of production are likely to occupy their attention.

In accordance with the theory of the freshman year, this course may be chosen by any member of the first-year class. The best approach, however, is said to be by Group II. of that year, comprising English, history, mathematics, chemistry or physics, and French, German or Spanish. The electives come only in junior and senior years; and the student will find his work closely laid out for him until then. The sophomore will take calculus, physics, his chosen modern language, a course in contemparary English, qualitative analysis, and mineralogy and crystallography.

In junior year the student will take physical chemistry, physical and historical geology, elementary metallurgy, drawing, industrial mineralogy, business finance, elementary economics, and more of the same sort of English. He may also elect from elementary botany, biology, or modern language, sufficient hours to fulfill the required number. When he becomes a senior, he will take general chemistry, economic geology, statistics and reports, industrial management, principles of accounting, elementary petrology and applied structural geology, metals and alloys, industrial management, and cost analysis. For electives, he may choose from elementary organic chemistry, industrial chemistry, economic and regional geology, business law, insurance, metallurgy of iron and steel, transportation and economic problems. The total of recitation, lecture, laboratory work and preparation comes to forty-six hours in sophomore year, forty-five and one half hours in junior year, and forty-five hours in senior year.

The pamphlet explains that "while no attempt is made to cover the entire field of natural and physical science as a foundation for the more practical business studies which form in the last two years an integral part of the course, attention is centered upon three branches of science, those of chemistry, geology, and metallurgy, the work in these sciences being so arranged that the natural and logical order of development is followed, covering in some cases four years of work in a single field. The scientific studies are supplemented in each of the years by general or cultural studies in English or modern language, and in junior and senior years by the study of economics, and of selected subjects within the general field of business administration."

STANDARDIZATION OF INDUSTRIAL LABORATORY APPARATUS

The Journal of Industrial and Engineering Chemistry states that through the efforts of certain apparatus manufacturers, there met informally at the Chemists' Club, New York City, representatives of the following companies to discuss the advisability of drawing up standard specifications for laboratory apparatus to be used in their industrial research and works control laboratories: Barrett Company, General Chemical Company, Atmospheric Nitrogen Corporation, Grasselli Chemical Company, National Aniline & Chemical Company, New Jersey Zinc Company, Solvay Process Company, Standard Oil Company of New Jersey, and E. I. du Pont de Nemours & Company.

Since most of these companies are members of the Manufacturing Chemists' Association of the United States, a committee composed of these members was appointed by the association to pass on the proposals of the informal committee and to recommend the adoption of the specifications resulting from the informal committee's work as standard for the members of the Manufacturing Chemists' Association.

Arrangements have been made for full co-operation with the committee on guaranteed reagents and standard apparatus of the American Chemical Society, and also with the committee on standards of the Association of Scientific Apparatus Makers. These specifications will be considered carefully by committees of these three societies, and it is expected that they will then be published as tentative for a period of 6 months in order to give time for general criticism. At the end of that time the specifications will be adopted as final. In carrying on this work an effort will be made to obtain specifications which will insure the cheapest mode of manufacture of a given instrument consistent with the duties that it must perform. The committee desires to co-operate fully with all industries, and any communications should be forwarded to the chairman, Dr. E. C. Lathrop, E. I. du Pont de Neumours & Co., Wilmington, Delaware.

SCIENTIFIC NOTES AND NEWS

HENRY ANDREWS BUMSTEAD, professor of physics at Yale University and director of the Sloane Physical Laboratory, on leave of absence this year to act as chairman of the National Research Council, died suddenly on the night of December 31, while returning from attendance on the scientific meetings at Chicago.

AT the Chicago meeting of the American Association for the Advancement of Science, vice-presidents of the association and chairmen of the sections were elected as follows: *Mathematics,* Oswald Veblen, Princeton University; *Physics,* G. W. Stewart, State University of Iowa; *Chemistry,* W. D. Harkins, University of Chicago; *Astronomy,* S. A. Mitchell, Leander McCormick Observatory, University of Virginia; *Geology and Geography,* Willet G. Miller, University of Toronto; *Zoological Sciences,* Charles A. Kofoid, University of California; *Botanical Sciences,* Mel T. Cook, Rutgers College; *Anthropology,* Albert Ernest Jenks, University of Minnesota; *Psychology,* E. A. Bott, University of Toronto; *Agriculture,* J. G. Lipman, Rutgers College; *Education,* Guy M. Whipple, University of Michigan.

PROFESSOR BRADLEY M. DAVIS, professor of botany at the University of Michigan, was elected president, and Professor H. E. Crampton, of Columbia University vice-president, at the Chicago meeting of the American Society of Naturalists.

THE American Society of Zoologists has elected as president Professor Charles A. Kofoid, of the University of California, and as vice-president Professor Aaron L. Treadwell, of Vassar College.

FIFTY-FOUR members attended the annual meeting of the American Society of Biological Chemists, Inc., held in Chicago from December 28 to 30. Officers elected for the year 1921 were: *President,* Donald D. Van Slyke; *Vice-president,* Philip A. Shaffer; *Secretary,* Victor C. Myers; *Treasurer,* Harold C. Bradley; *Additional Members of the Council,* Stanley R. Benedict, Otto Folin and Walter Jones.

DR. E. E. SLOSSON, associate editor of *The Independent* and formerly professor of chemistry in the University of Wyoming, has been elected editor of the Science Service, the temporary headquarters of which are at 1701 Massachusetts Avenue, Washington, D. C.

J. D. MACKENZIE has succeeded Charles Camsell, now deputy minister of mines, in charge of the British Columbia office of Geological Survey at Vancouver.

PROFESSOR SANARELLI, director of the Institute of Hygiene of the University of Rome, and editor of *Annali d'Igiene,* and Dr. Nicola Badaloni, a well-known writer on social medicine, have recently been made Roman senators.

Mr. Frank Bachmann has resigned his position as chief chemist, Industrial Waste Board, Connecticut State Department of Health, to accept a position in the sanitary engineering department of the Dorr Company of New York City.

R. S. Woglum, entomologist in charge of citrus fruit insect investigations in California for the Federal Bureau of Entomology, who for many years has been conducting researches in orchard fumigation with hydrocyanic acid, resigned on September 1 to head the newly established Bureau of Pest Control, in the California Fruit Growers Exchange, a cooperative organization of more than 10,000 citrus fruit growers.

Dr. John Lovett Morse, professor of pediatrics at the Harvard Medical School, who has been connected with the university since his graduation in 1887, has resigned, his resignation to take effect on July 1.

Professor A. B. Macallum, of McGill University, Montreal, will deliver a course of lectures, extending over seven months, at the medical college in Peking, China. He will leave for the Orient in March.

At the annual meeting of the Washington Academy of Sciences held on January 11, Dr. J. R. Johnston, chief of the Office of Plant Sanitation, Cuba, and director of research for the United Fruit Company, delivered the address on "Some problems in economic biology in tropical America." The 153d meeting of the academy will be a joint meeting with the Chemical Society of Washington and will be held in the Assembly Hall of the Cosmos Club (entrance on the south side of Cameron House) at 8:15 P.M., on Thursday, January 20, 1921. The retiring president of the academy, Dr. C. L. Alsberg, chief of the Bureau of Chemistry, U. S. Department of Agriculture will deliver an address on "The relation of chemical structure to physiological action."

The Cutter lectures on preventive medicine and hygiene were delivered at the Harvard Medical School on January 11 and 12, by Dr. Alonzo Taylor, on "General and specific effects of prolonged subnutrition."

Professor E. W. Skeats, of the University of Melbourne, Australia, made an address on January 4 before the Geological Conference at Harvard University on "The geology of the state of Victoria."

Professor John Merle Coulter, head of the department of botany at the University of Chicago, gave two lectures in Cleveland last month on the McBride Foundation of Western Reserve University. The subject of the lectures was "History and present status of organic evolution." The purpose of the Foundation is to offer to the citizens of Cleveland semi-popular lectures upon various subjects by representatives from other universities.

Services in memory of the late Major-General William C. Gorgas will be held in the hall of the Americas of the Pan-American Building, January 16, under the auspices of the Southern Society of Washington. The Secretary of War, Secretary of the Navy, Secretary of State, Adjt.-Gen. Peter C. Harris, Sir Auckland Geddes, and diplomatic representatives of Cuba, Panama and South American countries will deliver memorial addresses.

The *Journal* of the American Medical Association writes that at the suggestion of the Niederrheinische Gesellschaft für Natur- und Heilkunde, a memorial tablet is to be placed on the birthplace in Bonn of the Berlin physiologist N. Zuntz, who died last spring. To the pupils and friends of Zuntz the society has issued an appeal for contributions.

Dr. John Emory Clark, professor of mathematics in the Sheffield Scientific School of Yale University from 1873 to 1901, died on January 3, in his eighty-ninth year.

Regis Chauvenet, president emeritus of the Colorado School of Mines, chemist and metallurgist, died in Denver recently at the age of seventy-eight.

Elijah P. Harris, emeritus professor of chemistry at Amherst College, has died at Warsaw, N. Y., at the age of eighty-eight. Dr. Harris retired as professor of chemistry at Amherst in 1907.

DR. NATHAN SMITH DAVIS, of Chicago, formerly dean of the college of medicine, Northwestern University, died on December 22, at Pasadena, at the age of sixty-two years.

AT the annual meeting of the Carnegie Institution of Washington the Station for Experimental Evolution and the Eugenics Record Office at Cold Spring Harbor, without loss of their identity were, for administrative purposes, combined into the Department of Genetics, with C. B. Davenport, director of the department, Dr. C. C. Little assistant director for the Station, and Dr. H. H. Laughlin assistant director for the office. Professor Harold D. Fish, now of the University of Pittsburgh, was reappointed research associate of the department of genetics.

W. L. HARDING, governor of Iowa, in coöperation with Honorable J. B. Payne, Secretary of Interior, called a National Conference on Parks in Des Moines, Iowa, to be held January 10, 11 and 12. An unusually strong program was presented relative to national parks, state parks and municipal parks.

THE annual meeting of the Eastern Division of the American Philosophical Association was held at Columbia University, New York City, on December 28, 29 and 30. The address of the president, Professor R. B. Perry, of Harvard University, on "The appeal to reason," was given at the annual dinner on the evening of December 29.

THE fifth annual meeting of the American Association of Petroleum Geologists will be held at Tulsa, Oklahoma, March 17–19, 1921. Since the organization of the association, at Tulsa, in 1917, the membership has grown from less than a hundred members to almost six hundred. The meeting last year was held at Dallas, Texas. The present officers are: *President,* Wallace E. Pratt, Houston, Texas; *Vice-president,* Alex W. McCoy, Bartlesville, Oklahoma; *Secretary-Treasurer,* Charles E. Docker, Norman, Oklahoma; *Editor,* Raymond G. Moore, Lawrence, Kansas. Prominent geologists from all parts of the United States have signified their intention of attending the meeting, and business of vital importance will be transacted.

THE National Research Council has available for free distribution a few copies of its Bulletin No. 5, "The Quantum Theory," by Dr. E. P. Adams, Princeton. This bulletin is a digest of the large number of highly technical mathematical-physical papers which appeared shortly before and during the war period, many of which have not been readily accessible to American physicists and mathematicians. Copies of the bulletin have already been sent to all regular members of the American Physical Society and to a selected number of mathematicians and astronomers.

THE Rockefeller Foundation has given to France complete control over the elaborate antituberculosis organization established in the department of Eure-et-Loir at a cost of 4,000,000 francs. The organization consists of twenty-four dispensaries, four complete isolation services, a departmental sanatorium and laboratory. The system will serve as a model for similar organizations to be established by the government throughout the country. The Rockefeller Foundation is now assisting in the antituberculosis campaign in thirty-eight of the eighty-seven departments and it is expected that this work will be continued for two years more.

UNIVERSITY AND EDUCATIONAL NEWS

DARTMOUTH COLLEGE will receive a bequest of $250,000 under the will of Sanford H. Steele, to erect a memorial to his brother, Benjamin Hinman Steele, of the class of 1857, for instruction and research in chemistry.

THE Yale Corporation meeting on January 8 again postponed the election of a president to succeed Dr. Arthur T. Hadley.

TRUSTEES of the Connecticut Agricultural College have voted to ask the incoming State Legislature to appropriate $625,000, of which $400,000 is wanted to erect a new science building for the chemistry, botany, physics and bacteriological departments. Plans for

the building call for a three-story brick and limestone structure, 40 by 180 feet. In addition to this special appropriation, the legislature will be asked to increase the regular state biennial appropriation from $150,000 to about $225,000, to help meet increased costs.

Dr. Henry Cuthbert Bazett has been appointed professor of physiology in the Medical School of the University of Pennsylvania to succeed Dr. Henry T. Reichert, who retired last year. Dr. Bazett is the Cheselden Welsh lecturer of clinical physiology at Oxford, England, and has been connected with St. Thomas' Medical School.

Dr. S. A. Mahood, who has been in charge of investigations on wood cellulose and essential oils at the U. S. Forest Products Laboratory, Madison, Wis., for the past three years, has become associate professor in charge of organic chemistry at Tulane University.

Dr. Kenneth D. Blackfan, associate professor of pediatrics at the Johns Hopkins Medical School, has been appointed to the professorship of pediatrics at the Medical College of the University of Cincinnati.

DISCUSSION AND CORRESPONDENCE

LEUCOCHLORIDIUM IN AMERICA

Since I published the description of *Leucochloridium problematicum*,[1] Dr. H. A. Pilsbry has very kindly called by attention to three articles which deal with members of this genus. All of these are works on conchology and are merely incidental to descriptions of certain snails, yet they are interesting since they show that collectors of mussels were more or less familiar with the parasite before parasitologists had studied it in America.

The first article is that of Dall,[2] who writes:

> A singular sausage-shaped parasite, of which one end is attenuated into a slender tube, is found in *Succinea*. The soft parts of the snail thus affected are much distorted. The parasite is one phase of a Distome or fluke-worm, and is of a dark brown color and over an inch in length. It is known as *Leucochloridium americanum* Dall. An analogous species has been described from French Succineas, which is of a mottled green. This parasite attains its development in the intestines of thrushes which feed on Succinea, and may perhaps be fatal to these birds.

Bryant Walker[3] refers to a *Leucochloridium* species as follows:

> *S. ovalis* Gld. Abundant everywhere. This species is occasionally infested by a species of Leuchchloridium similar to the *L. paradoxum* Carus, found in the *S. putris L.* of Europe and figured by Baudon in *Jour. de Conch.*, V., 27, Pl. X., Fig. 6. In the same journal (V. 28, p. 205) is published a note from the late Thomas Bland, recording a similar occurrence in a specimen of *S. obliqua* Say.

Finally Hanham[4] states:

> *Succinea obliqua* Say (St. Charles River). . . . In cleaning some of these shells taken on November 8, 1891, a few of the finest living specimens contained peculiar parasite, reference to which is made by Dr. Dall in his useful pamphlet "Instructions for Collecting Mollusks, etc.," (*Leucochloridium*).

Since Dall gave the specimen a name some consideration of it is necessary. It is of course impossible to identify the worm since he did not describe it. The sporocyst was evidently more than one inch in length. The only other descriptive statement is that it "is of a dark brown color." If one is to construe this expression to mean that the sporocyst is solid brown, it is certainly not *Leucochloridium problematicum* Magath. From the text it seems to me one can not assume anything else.

It is interesting to note that all early references to the finding of the parasite in Amer-

1 Magath, T. B., "*Leucochloridum problematicum* N. sp.," *Jour. Parasit.*, 1920, VI., 105–115.

2 Dall, W. H., "Instructions for Collecting Mollusks and Other Useful Hints for the Conchologist," U. S. National Museum, Bull. 39, Part G, 1892, p. 10.

3 Walker, B., "The Shell-bearing Mollusca of Michigan," *Nautilus*, 1892, VI., 18.

species as follows:

4 Hanham, A. W., "Notes on the Land Shells of Quebec City and District," *Nautilus*, 1897, X., 102.

ica have been made by conchologists. This perhaps explains the lack of morphologic description of the parasite from America prior to 1920 since it was only of passing interest to snail collectors. It would be splendid if men who have the opportunity to collect certain groups of animals would save and turn over the parasites and symbiotic animals to those interested in these particular fields, and certainly we would work out life cycles much faster if this attitude were taken by professional collectors.

THOMAS BYRD MAGATH

MAYO CLINIC,
ROCHESTER, MINN.

SOME SIMPLE GENERATORS OF HIGH FREQUENCY OSCILLATIONS

TO THE EDITOR OF SCIENCE: In SCIENCE for October 15 is printed a letter from Mr. G. M. J. Mackay concerning the utility of helium as a convenient source for the production of high frequency oscillations. In this connection it may be of interest to call attention to some other simple forms of generators.

About fourteen years ago the writer was engaged to conduct some experiments for the late Professor Kristian Birkeland, of the Christiania University who, from observations made on his electric furnaces for the fixation of nitrogen, was led to believe that the arc, as therein used, was partly of an oscillatory nature. Birkeland's idea was to produce high frequency oscillations without the use of hydrogen, by simply keeping the arc in motion by means of a magnetic field, with a view to utilizing the oscillations for wireless telephony.

His idea also proved correct, as high frequency oscillations could easily be produced between two circular, water-cooled copper electrodes in a radial magnetic field. Telephonic messages were also transmitted by these means from the university buildings to Bygdoe, a distance of about two miles; but the hissing noises due to the arc made understanding very difficult.

In the device used, the electrodes were arranged horizontally, the upper electrode resting by its weight against the lower one. On switching on the current, the upper electrode was lifted a fixed distance by an electromagnet carrying the main current. This arrangement served to start the arc automatically whenever it went out, a thing that did not happen very often, however, when the apparatus and current were properly adjusted, the arc sometimes burning for hours without interruption. While the available voltage was 220, the voltage between the electrodes was comparatively low, to the best of my recollection about 50.

The energy of the oscillations was sufficient to permit a continuous spark of more than 1 cm. length to be drawn from the secondary circuit, easily melting the point of a thick iron wire. Moreover, it was found possible to increase this energy considerably by working up to three arcs in series on the above voltage. As a latter arrangement did not adversely affect the stability of the arc there seems to be no limit to the amount of energy that may thus be converted into a high frequency current.

An interesting phenomenon was discovered while working this type of a generator: While the oscillatory arc made the impression of a rotating cluster of fat, white sparks, producing a crackling sound, it would, when the current was properly reduced, completely change its character. The fat, white sparks would gradually disappear, giving way to a pale blue, almost noiseless arc, consuming only a fraction of the initial current. When this condition had been attained no current would flow through the primary oscillation circuit which could be detached without any effect on the arc. The latter was also fairly stable, but at a sufficient reduction of the current, or weakening of the magnetic field, it would go out with a sharp click. This arc strikingly resembled the glow obtained by discharges through moderately rarefied air.

In the course of the experiments, other surrounding media than air were tried, among them water. One day it was found that in using the latter medium it was not necessary

to subject the arc to the action of a magnetic field in order to produce oscillations. In fact, the oscillations obtained by simply immersing two copper rods in water and starting an arc between them were much more powerful than those produced by a single arc in air, and the stability of the wet arc left nothing to be desired.

This discovery so discouraged Professor Birkeland from pursuing his original line of investigations that the experiments were dropped.

Anders Bull

Chicago, Ill.,
October 25, 1920

ROMANCING IN SCIENCE

To the Editor of Science: "O tempus! O mores!" To one who has used Professor Cajori's book with some confidence, his reply[1] to Dr. Partridge is disturbing. Dr. Partridge concluded[2] that we do not know exactly what experiment Galileo performed from the leaning tower of Pisa. Professor Cajori in reply offers data that (apparently unintentionally) substantiate Dr. Partridge's statement, but he says that it appears to him *too sweeping*.

In Professor Cajori's "History of Physics" (p. 32) the following detailed account occurs:

> The first experiments, which Galileo made while he was a young professor at Pisa, were decidedly dramatic. At that time the doctrine that the rate at which a body falls depends upon its weight was generally accepted as true, merely on the authority of Aristotle. It was even held that the acceleration varies as the weight. Prior to Galileo it did not occur to any one actually to try the experiment. The young professor's tests went contrary to the doctrine held for two thousand years. Allowing for the resistance of the air, he found that all bodies fell at the same rate, and that the distance passed over varied as the square of the time. With all the enthusiasm, courage and imprudence of youth, the experimenter proclaimed that Aristotle, at that time believed by nearly every one to be verbally inspired, was wrong. Galileo met with opposition, but he decided to give his opponents ocular proof. It seems almost as if nature had resorted to an extraordinary freak to furnish Galileo at this critical moment in the history of science, with an unusual convenience for his public demonstration. Yonder tower of Pisa had bent over to facilitate experimentation, from its top, on falling bodies. One morning, before the assembled university, he ascended the leaning tower, and allowed a one pound shot and a one hundred pound shot to fall together. The multitude saw the balls start together, fall together and heard them strike the ground together. Some were convinced, others returned to their rooms, consulted Aristotle, and, distrusting the evidence of their senses, declared continued allegiance to his doctrine.

In his reply to Dr. Partridge, Professor Cajori gives "*the* historical data" and says that from them "it follows that Galileo dropped different weights of a variety of materials and noticed which of them fell faster."

Now, Mr. Editor, from what data does the above quoted thrilling account follow? And from what data and by what processes may other parts of history be reconstructed by scientists? And from what data must it follow in your readers' minds that Dr. Partridge is the scientist guilty of a "declaration" that is "too sweeping"? Recently it cost me many hours of painstaking experimentation to prove that certain improbable statements made in print by a scientist were directly contrary to fact; when the results of the investigation were sent to him, he replied that his had been *merely casual remarks!* Your correspondent happened to see the following in his Montaigne this morning, *Fortis imaginatio generat casum*—there translated, "A strong imagination begetteth chance."

David Wilbur Horn

Bryn Mawr, Pennsylvania

[1] Science, October 29, 1920.

[2] Science, September 17, 1920.

A THRICE TOLD TALE

The conversation which Professor Campbell describes, in a recent number of Science, as taking place at the eyepiece of the Lick telescope in September, 1912, prompts me to quote the closing paragraph of my article on the mercury telescope which appeared in the *Scientific American* for March 27, 1909.

I am tempted, in closing, to tell of the remark made to me by one of the older inhabitants of East Hampton who had paid my laboratory a visit. The milky way happened to be overhead and the mouth of the telescope pit was filled with hundreds of star images. "What are they all anyway?" he asked. "Suns like ours, only bigger," I replied. "You don't say so," he answered, "and have they earths and planets and things going round 'em, and are they all inhabited?" "Very likely," said I, "some people think so." He scratched his head and then turned to me with a restful smile and said, "Well, do you know, I dunno as it makes so *much* difference after all whether Taft or Bryan's elected."

The similarity between the two conversations leads me to believe that Professor Campbell's questioner was leading for an opening to repeat the remark of the old farmer.

Others have been similarly victimized, for in G. Lowes Dickinson's "Appearances" published in 1915, on page 163 a similar conversation occurs between the author and a lone telegraph operator in a railroad shack in the Rockies.

From one newspaper topic to another we passed to the talk about signalling to Mars. Signalling interested the youth; he knew all about that, but he knew nothing about Mars or the stars. These were now shining bright above us, and I told him what I knew of suns and planets, of double stars, of the moons of Jupiter, of nebulæ and the galaxy, and the infinity of space and of worlds. He chewed and meditated, and presently remarked, "Gee! I guess that it doesn't matter two cents after all who gets elected president."

Should it be discovered that the story appears also in the writings of Galileo, or Copernicus, or Pythagoras, it will mean that I too have been victimized.

R. W. WOOD

ARE THE LANCE AND FORT UNION FORMATIONS OF MESOZOIC TIME?

IN a paper recently published by Dr. Stanton we have for the first time a description of the complete fauna of the Cannonball member of the upper Lance formation, consisting of 73 forms; 2 are sharks' teeth, 6 are cup corals (described in an appended paper by T. W. Vaughan), 2 are foraminifers, and the rest are molluscs (31 bivalves, 1 scaphopod, and 31 gastropods). There are 41 new forms, and 2 remain unnamed specifically. Of the 71 invertebrates, but a single bivalve passes upward into the Fort Union freshwater beds (*Corbula mactriformis*), while 24 forms occur below in the marine Fox Hills or older Cretaceous formations. Not one of the species of the entire Cannonball fauna is known in the marine Eocene province of the Gulf of Mexico. In other words, "40 per cent. of the molluscan species in the Cannonball fauna are known in the combined Pierre and Fox Hills or Montana fauna of the same general region, and 30 per cent. of them have been found in the Fox Hills fauna. . . . The fauna clearly belongs to the open sea and was modified after Fox Hills time by the extinction" of the ammonoids and other forms, "and by the introduction of a considerable number of new types that are not known in the Fox Hills and Pierre faunas" (p. 12). This new element, however, is not distinctively Cenozoic, but consists of types that are elsewhere found in the Cretaceous.

Again, the Fox Hills fauna is about of the time of the *Exogyra costata* zone of the Atlantic and Gulf Coastal Plain. The last named fauna has, according to Stephenson, 168 molluscs, and yet not a single one passes upward into any Cenozoic formation. From these and other facts Stanton concludes that "a large element in the Cannonball fauna is directly descended without specific change or with only slight change from the preceding Cretaceous faunas of the Rocky Mountain and Great Plains region. These late Cretaceous faunas show a progressive modernization due to the gradual elimination of distinctive Mesozoic generic types and the concurrent introduction of modern generic types which continued through the Tertiary and are still living in the Recent fauna" (p. 12).

[1] "The Fauna of the Cannonball Marine Member of the Lance Formation," by T. W. Stanton, U. S. Geol. Survey, Prof. Paper 128-*A*, pp. 1–66, Pls. 1–10, 1920.

"It is my opinion that the fauna of the Cannonball marine member of the Lance formation indicates that the formation belongs within the hiatus discussed by Stephenson and below the line which he postulates as separating Cretaceous from Eocene. It is certainly somewhat younger than the zone of *Exogyra costata* and most probably considerably older than the Midway formation" (p. 15).

The regularly bedded marine Pierre strata pass unbroken into the irregularly bedded Fox Hills formation, this irregularity of bedding being due to tidal currents in the shallowing waters of a retreating sea. Above the Fox Hills, and without important break, lies the Lance, which is in the main of fresh-water beds ranging in thickness from 400 to 525 feet, and which has a Fort Union-like flora and ceratopsian dinosaurs. Then the marine waters return for the last time in the area of the Great Plains and deposit in the eastern part of the area of the Lance formation the Cannonball marine member, whose fresh-water equivalent is known as the Ludlow lignitic member, the two having each a maximum thickness of about 300 feet. To quote Stanton again:

> The Cannonball marine member rapidly thins toward the west until it is reduced to one or two thin beds which extend as tongues into the predominantly continental deposits of the Ludlow lignitic member (p. 9).

On the other hand, this lignitic member is difficult to distinguish from the overlying Fort Union. Hence we see that there is here a continuous and unbroken series of deposits from the Pierre and Fox Hills into the top of the Fort Union, and that the reported erosion contacts between the several formations are due to nothing more than changes from marine to brackish and fresh-water deposition, or to the irregularities characteristic of continental sediments, the local breaks not representing a loss of geologic time of any marked historical value.

Finally, Stanton presents two paleogeographic maps, one showing the position of the marine Lance with reference to the Pierre sea, and another to the Eocene seas. These maps are a most striking summation of the problem in hand, and at once bring out the fact that the Cannonball member is most closely related to the final Cretaceous seas, since there is no possibility of connecting these marine beds with those of the Eocene of the Gulf of Mexico area, or the Pacific Ocean.

Modern stratigraphers know well that it is more commonly the earlier and especially the middle formations of the periods that are preserved, and that the later parts are more or less absent. As a result of this, the systems of rocks are separated from one another by "breaks," representing intervals of time of varying length, when erosion was going on. No geologist can tell from the stratigraphy or the entombed faunas and floras how long these intervals lasted, but in favorable localities are often found sediments not only hundreds but thousands of feet in thickness which on the basis of their contained organic evidence can be shown to supply the record lost elsewhere in one of these breaks. Why is it that the later parts of the systems of strata are absent? In some cases this is due to lack of deposition, but, as above indicated, in most instances it is because of the inter-system erosion times. The strata last deposited are first to vanish under the influence of erosion, and their absence is almost general in stratigraphy for all the older periods of geologic time. In the more modern periods, however, we should expect the preserval of some of these latest strata of the rock systems, and the Lance with its marine Cannonball member and the overlying Fort Union appear to be the last deposits of the Cretaceous. They have long been known as the transition formations into the Eocene, but even so they do not fill the entire gap between the Pierre of the Cretaceous and the Wasatch of the Eocene. As LeConte says:

> But, as the change was gradual and the sedimentation continuous, of course the strata were in places conformable throughout. Thus, then, the Cretaceous was before, the Tertiary after, and the Laramie [in which he includes the Lance, Fort

Union, etc.] during, the Rocky Mountain revolution ("Elements of Geology").

The reviewer therefore does not hesitate to state that to him the evidence relating to the field relations and stratigraphy, the orogeny and paleogeography, and the invertebrate and vertebrate fossils of the Montana series and the Fox Hills and Lance formations is now well enough in hand to conclude that all are unmistakably of Mesozoic time. Furthermore, as the Lance and Fort Union are continuous formations, have wholly archaic mammal faunas, and are broken by a period of orogeny and lack of deposition from the succeeding Eocene deposits with their wholly different and modernized mammal faunas, the line separating the Mesozoic from the Cenozoic apparently lies between the Fort Union and the Wasatch, and not between the Fox Hills and the Lance. From this conclusion the paleobotanists will of course dissent, but we have now come to the parting of the ways. Our floral brethren will continue to say that the Cenozoic begins with the Lance, but the dominating faunal evidence of the invertebrates and vertebrates, backed as it is by the field relations and the two movements of the Laramide revolution, binds invertebrate paleontologists and geologists together in the conviction that the Lance and the Fort Union are of Mesozoic time. The U. S. Geological Survey should now reverse its former conclusion and adapt itself to the fuller evidence.

CHARLES SCHUCHERT

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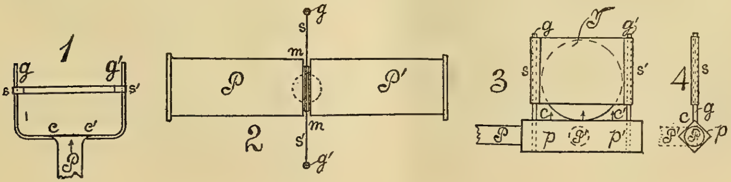
SPECIAL ARTICLES

AN ADJUSTABLE EMBOUCHUER

THE device shown in Fig. 1 was designed to evoke a definite note, fundamental or overtone, from cylindrical tubes, closed at one end or open at both. It consists of a brass tube *P*, pinched down at *cc′*, so as to form a crevice 2 or 3 cm. long and not much more than ½ mm. broad. From this issues a lamina of air striking the strip of thin brass *ss′* about 5 mm. broad. The strip *ss′* which is always to lie in plane of the lamina, is on guides *gg′* of thick copper wire, bent at right angles, as shown, and soldered to the ears of the crevice *cc′*. In proportion as a higher or lower note is to be evoked, *ss′* is placed nearer *cc′* or removed from it; for the nearer *ss′* is to *cc′* the higher the mean pitch of the siffling. For high overtones the adjustment is rather delicate and should be made (preferably) with a micrometer. In Fig. 1, *ss′* slides with slight friction and is moved by the fingers. In use, the apparatus is placed across the end of the pipe with the plane *gcc′g′* normal to the axis. The particular note wanted is obtained by correctly setting *ss′*, which operation sometimes requires patience. The best results are obtained with pipes of the one-foot octave, and of a diameter less than twice the width *cc′*, pipes of about equal width with *cc′* being most satisfactory. From inch gas pipe, two feet long, a whole series of overtones may be evoked in succession. With a less exacting demand for an immediate response, clear notes may be obtained from a great variety of vessels. Thus bottles, deep tumblers and beakers, flat jars (like sardine boxes), truncated cones, thistle tubes and even thimbles respond, often very loudly.

Very disconcerting sounds are often obtained. Thus, for a wide-mouthed cylindrical jar, 3″ in diameter and 6″ high, tapering



down at the top to a mouth $1\frac{1}{2}''$ in diameter, the fundamental appears at once (*ss′* across the middle). If now the distance *sc* is decreased, the overtone will appear loudly. It is *not* the fifth above, however, but the *octave*, itself. As the kinematics of the stationary waves are given, the overtone belongs to an original wave of 3/2 longer wave-length than the fundamental.

Figure 3, 4, is another form of blower adapted for wide pipes, made of square brass tubing *pp′*. One edge of this has been filed down until a rift *cc′* may be cut with the fine blade of a knife. The strip *ss′* here advantageously covers the pipe *T* to be tested; or the hands may be used to cover projecting sides of *T*. The form, Fig. 3, with an alternative influx *P′*, may be duplicated, affording two opposed rifts and strips. Tin cups, funnels, etc., as well as long wide tubes respond to it sonorously.

Interference.—This experiment succeeded beautifully with the strip *ss′* of the blower, Fig. 1, placed between two coaxial pipes, *P* and *P′* (Fig. 2), each about 10 cm. long and 2 cm. in diameter (for instance) and closed at the outer end. Either pipe alone sounds vigorously when in position and actuated by the blower. With the two together there is a mere siffling, the wave running from end to end of the (virtually) double closed pipe *PP′*. Nevertheless, there is abundant room at *mm* for the escape of sound; indeed, one pipe, *P*, for instance, may even be placed at right angles to the other, leaving a wide open space, and still almost the whole compression of one pipe is alternatingly absorbed by the other. The experiment is an excellent illustration of the *reversal* of spectrum lines.

The nodes here are respectively dense and rare; *i.e.*, always opposite in the two pipes. Hence, the interference. In the cross pipe used heretofore, the nodes were necessarily identical in sign, and, therefore, gave marked reenforcement. The same will be true if the pipes *P*, *P′* are each open at the further end.

Carl Barus

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THE WESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The first Annual Meeting of the new Southwestern Division of the American Association for the Advancement of Science was held in El Paso, Texas, on Thursday, Friday and Saturday, December 2, 3 and 4, 1920. The officers at the meeting, elected at the Organization Meeting in April, 1920, were: President, Dr. Edgar L. Hewett, of Santa Fe; Vice-president and chairman of the Executive Committee, Dr. E. C. Prentiss, El Paso; Secretary-Treasurer, Dr. A. E. Douglass, Tucson. The Executive Committee included also Dr. John D. Clark, Albuquerque, Mr. A. L. Flagg, Phoenix, Professor Fabian Garcia, Mesilla Park, Mr. Arthur Notman, Bisbee, Mr. Robert S. Trumbull, El Paso, Professor Milton Updegraff, Prescott and Dr. Chas. T. Vorhies, Tucson. Dr. D. T. MacDougal was chairman of the organization committee. The affiliated societies participating in this meeting were, The American Association of Engineers, Southwestern District, The Medical and Surgical Association of the Southwest, The New Mexico Archæological Society. The Sante Fe Society of the Archæological Institute, The Mexico Medical Society and the El Paso County Medical Society. The trustees of Temple Mount Sinai loaned their very convenient rooms and auditorium for two days. The El Paso High School did the same for the final day and provided lunch. The Ad Club of El Paso entertained the members at lunch; the El Paso County Medical Society were hosts at a reception and dance at the Toltec Club. Excursions to points of interests were provided.

An important event of the meeting was the session on Friday afternoon in the Mexican City of Juarez. As the members entered the Juarez theater, they were received with the strains of the "Star Spangled Banner," played by a Mexican military band. This was followed by the Mexican National

Anthem. An address of welcome was given in English by Sr. Esquival, a response by Dr. Hewett, a welcome by the president of the Chamber of Commerce of Juarez, an address in Spanish by Sr. Ignacio Salas, special representative of the Mexican government, reading of papers, a response to the address of Sr. Salas, by Dr. D. T. MacDougal, closing with "America" given by the military band. The members visited the Agricultural College in Juarez, the old church and other points of interest.

The papers presented at the El Paso meeting occupied four sessions and were given in three sections, Human Science, Biological Science and Physical Science. The subjects specially dealt with were Psychology, Archæology, Education, Forestry, Ecology, Bacteriology, Astronomy, Geology, Chemistry and Medicine. Besides these a half day was devoted to a Symposium upon Southwestern problems. Dr. MacDougal of the Carnegie Institution spoke on Organization of Scientific Interests; Dr. Coan of the University of New Mexico, on Salient Historical Features; Dr. Shreve of the Desert Botanical Laboratory, Tucson, on Plant Distribution in the Mountains, Dean Working, of the University of Arizona, on support of Agricultural Research, Mr. Lawson of the U. S. Reclamation Service, on Reclamation Problems, Dean Butler, of the University of Arizona, on Mining Industry and Dr. Prentiss of El Paso, on Special Features of Medical work in the southwest. The presidential address by Dr. Edgar L. Hewett given Thursday evening in the auditorium of Temple Mount Sinai, was entitled "The Southwest—Yesterday and Tomorrow." It dealt with anthropological lines closely related to the subject of the Symposium. The chief address at the opening meeting on Thursday was by Dr. David Spence Hill, President of the University of New Mexico, on Basic Principles of Research.

In the final business session, a new Executive Committee was elected, consisting of Dr. Edgar L. Hewett, Santa Fe, Dr. John D. Clark, Albuquerque, Dr. V. M. Slipher, Flagstaff, Mr. A. L. Flagg, Phoenix and Professor Romulo Escobar, Juarez, Resolutions of thanks and of appreciation of Mexican cooperation were passed. In a meeting of the executive committee, Dr. A. E. Douglass of the University of Arizona, was elected president and Dr. E. C. Prentiss, of El Paso was elected vice-president and chairman of the executive committee. The secretary-treasurer for the year 1921 will be Mr. Howard W. Estill of the chemistry department of the University of Arizona.

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

The use of platinum crucibles in electro analysis. Copper determination: Harold Van Doren and James R. Withrow; and *The use of platinum crucibles in electro analysis. Rapid Copper determinations:* Rufus D. Reed and James R. Withrow. We have found that platinum crucibles can be used with proper precautions as readily as platinum dishes and more satisfactorily than flag electrodes for this purpose. Early workers in electro analysis naturally used platinum crucibles but the development of this application of chemistry brought in a variety of other forms, losing sight of the simpler form whose use is now made imperative for economical reasons. The application of the ideas of Richards and Bisby for crowding the current density in a small volume between two platinum crucibles within each other has been tried out and found with slight modification to be eminently satisfactory. Toluene has been found more satisfactory to prevent spraying than kerosene which can be used and which was suggested by Richards and Bisby.

Preparation of manganates and permanganates: H. McCormack. This paper embodies a short description of the customary method for the production of sodium and potassium permanganate and indicates some of the complications in this process and the desirability of avoiding such difficulties by the modification of the process. The modification suggested consists in the crystallization of the sodium or potassium manganate, formed in the reaction between alkaline hydroxide and manganese dioxide, from alkaline solution. The permanganate is then formed by dissolving the manganate crystals in water and oxidizing by some suitable oxidizing agent. The method of oxidation recommended is electrolytic, using an

iron anode and cathode with an asbestos cloth diaphragm. A brief summary of results which have been obtained when operating on a commercial scale when using this method is given, and the advantages of operating in this manner as compared with the customary procedure are emphasized.

Estimation of benzene in admixture with paraffin hydro-carbons: H. McCormack. There is a considerable quantity of material being used to-day, particularly for motor fuels, which consists of a mixture of benzene and its homologues with gasoline. This has emphasized the desirability of securing a satisfactorily rapid and accurate method of estimating the quantity of benzene which may be present in such admixtures. Considerable study has been given this question by various observers and most of the properties of the compounds which may be present in such admixtures have been utilized from time to time in attempting such estimation. The methods which have heretofore been employed may be separated in two divisions. The methods of accuracy which are long and tedious, and methods of little accuracy which will be used in a short time. This paper describes a method by which the benzene is estimated from the quantity of bromine absorbed in the formation of di-brom benzene. Further work is in progress to determine the possibility of applying the method to estimation of commercial benzol in commercial gasoline where we will have present not only benzene and paraffin hydro-carbons, but also toluene, xylene, and other benzene derivatives.

The permanganate determination of sulfur dioxide: H. S. Coith and James R. Withrow; *The action of permanganate upon sulfur dioxide and sulfides:* F. C. Vilbrandt and Samuel L. Shenefield and James R. Withrow; and *The iodometric determination of sulfur dioxide:* Gordon D. Patterson and James R. Withrow. These three papers represent a study on various phases of the determination of sulfur dioxide from sulfuric acid plant and smelter fumes. The permanganate reaction with SO_2 proves to be the exception to the rule that permanganate goes to the MnO stage of oxidation in presence of sulfuric acid and sulfites going in part only to the MnO_2 stage, as is familiar in alkaline reactions. We have found in the case of the iodometric method which has proved satisfactory in the Marsden modification used by the Selby Smelter Commission that it can be applied also to high concentrations of sulfur dioxide if the color matching is not brought back to the original iodine color but the blank color brought down by thiosulfate to the end color of the SO_2 specimen.

Uniform packages for reagent chemicals: W. D. Collins. In order to secure better service in deliveries of reagent chemicals and to decrease the possibility of contamination in packing the following suggestions are made. (1) A set of standard sizes of packages for each reagent chemical should be adopted by the American Chemical Society. One fairly large and one small size would suffice for most reagents. Five hundred grams and either 100 or 25 grams would probably be selected. (2) Reagents should be sold by weight in grams. (3) Purchasers desiring reagents packed in other than standard packages should expect to pay proportionately more than for the standard packages.

Uniform specifications for chemical thermometers: R. M. Wilhelm.

Recovery of industrial gases with activated charcoal: O. L. Barnebey.

Evidences of auto-catalysis in the hydrogeration of cotton seed oil: O. R. Sweeney and Joseph Ellert. A series of experiments are given which were carried out to establish the best hydrogeration conditions using cobalt as the catalyzer. The shape of the curve (slope) indicated that auto catalysis was effecting the results. Experiments were made which seem to bear this out. Since this has never been observed, as far as we can learn, it would seem to be a matter of the utmost importance in view of the very considerable amount of research work being done along this line at present.

The use of ammonia oxidation to replace nitre in chamber plants: Charles L. Parsons. The large saving which is to be made by the use of ammonia oxidation instead of producing nitric acid in the ordinary way where the oxides of nitrogen are to be used in a gaseous form has already been pointed out by the author in the *Journal of Industrial and Engineering Chemistry,* Volume 11, page 451, 1919. On the recent trip to Europe a study was made of the practise in those countries, and it was found that ammonia oxidation was rapidly replacing any other source of oxides of nitrogen. In Germany this method was used almost exclusively, while in England some thirty plants have already adopted it, and no plant which has adopted it has changed back to niter. The plants which were visited and

some details of the operations in those plants were given.

A study of the separation of iron from aluminium by precipitation as Prussian Blue: G. O. BURR and HARRISON HALE. Precipitation of Prussian Blue from ferric salts with potassium ferrocyanide in the presence of aluminium was tried. Different concentrations of the salts and different strengths of free acid were used. It was found that the method was not applicable because of the formation of complex aluminium potassium ferrocyanides and the difficulty of filtering the Prussian Blue.

Fuel Symposium. A. C. Fieldner, *chairman*

Low temperature carbonization and its application to high oxygen coals: S. W. PARR. By low temperature carbonization is meant decomposition at a maximum temperature of 750°–800° C. This is not an arbitrary range but is a natural division below which substantially all condensible volatile products are discharged and the minimum amount of secondary decompositions occur. The main points of interest were fully summarized and described. In general, it is believed that all of the products of decomposition have a higher intrinsic value as delivered under low temperature conditions, chiefly because of the avoidance of excessive secondary decompositions. The solid residue is a smokeless fuel of from 5 to 15 per cent. volatile, free burning and of good texture, primarily adapted to use as a domestic or factory fuel. Whether suitable for metallurgical purposes or not has not been determined.

Carbonization of Canadian lignites: EDGAR STANSFIELD. This paper summarizes the results of an investigation on the carbonization of Canadian lignites carried out by the Mines Branch of the Department of Mines, and by the Lignite Utilization Board of Canada, at the Fuel Testing Station, of the Mines Branch, at Ottawa. The first series of experiments was carried out on 10 gram samples with exact temperature control, it showed the effect on the resulting carbonized material of widely differing conditions of carbonization: the results obtained have been used to control all larger scale work. The second series of experiments was carried out on samples of 1–3 kilograms. The experiments were similar to the above, but the tar, gas, ammonium sulphate, and water was also collected and studied. A weight balance sheet, thermal balance sheet and other results obtained in one set of experiments are given. The bearing of the above results, and of the economic conditions in southern Saskatchewan, on the design of a commercial carbonizer for that district are discussed, and the evolution from this laboratory investigation to the successful operation of a semi-commercial carbonizer of new design is traced. This carbonizer treated some 200 pounds of dried lignite per hour; the experience gained with it has been used to design a plant now being built by the board, near Bienfait, Saskatchewan, to treat 200 tons of raw lignite per day.

By-product coke. Anthracite and Pittsburgh coal as fuel for heating houses: HENRY KRIESINGER.

By-product coking: F. W. SPERR, JR., and E. H. BIRD. The paper discusses the present growth of by-product coke manufacture due to the increased use of its products as fuels. This growth is even, to a considerable extent, becoming independent of the iron and steel industry. The fuel efficiency of the by-product coke oven and the beehive oven are compared. The primary products of the by-product coke oven are discussed with relation to their use as fuel. There have been a number of new applications of these products that are important from this standpoint. The gaseous fuels manufactured from coke are also described, together with the possibilities for their future use in systems for the complete gasification of coal. The economical relation of the Koppers' combination oven fired with producer or blast furnace gas is noted, and other recent technical developments which have contributed to fuel economy are cited.

The charcoal method of gasoline recovery: G. A. BURRELL, G. G. OBERFELL and C. L. VORESS.

Colloidal fuels, their preparation and properties: S. E. SHEPPARD. Reasons for name, and history of development—colloid chemistry and fuels—suspensoids and emulsoids—viscosity conditions and stability requirements—stabilizing by protective colloids—development of plastic inner friction and "plasma" structure—peptization processes in theory and practise—accessory testing methods and practical trials.

Gasoline losses due to incomplete combustion in motor vehicles: A. C. FIELDNER, G. W. JONES and A. A. STRAUB.

Enrichment of artificial gas with natural gas: JAMES B. GARNER. The project of enriching artificial gas with natural gas is one which is of wide spread interest because of its possibility of providing a supply of a clean domestic fuel gas, uniform in quality and of sufficient volume to meet

the requirements of the public. This is particularly so in regions where natural gas has been used. Gas is more convenient, more economical and safer to use than any other fuel. There are in nature three potential sources of raw materials adequate for the production of a future domestic supply of manufactured gas. These three potential sources are bituminous shale, oil and coal. Artificial gas, as produced on a commercial scale, consists of the following varieties: Shale gas, oil gas, producer gas, water gas, carburetted water gas, coal and coke oven gas. The manufacture of a domestic supply of water gas, enriched with natural gas, serves two purposes—(1) It conserves in the highest possible manner our natural resources of coal, oil and gas and (2) it insures to the public an adequate supply at all times of a clean, uniform gas at the lowest possible cost. Natural gas companies should no longer be permitted to sell natural gas as such at ridiculously low rates but should be required to utilize it in the highest possible way, viz.: as a means of enriching artificial gas. Such use of this natural resource will insure to the public, for many years to come, a supply of gas at a cost otherwise impossible.

The commercial realization of low temperature carbonization: Dr. Harry A. Curtis. The carbocoal process for converting bituminous coal into a uniform, smokeless fuel resembling anthracite was developed by the International Coal Products Corporation at its experimental plant in Irvington, N. J. Both small apparatus and commercial size units have been in use there for the past four years, and there has been an opportunity to compare the results obtained in laboratory tests with those of plant operation. In the carbocoal process the crushed coal is carbonized first at a low temperature (900° F.), the resulting semi-coke is then ground and briquetted with pitch. The briquets are finally carbonized at somewhat below coke-oven temperature (1800° F.). The resulting fuel, carbocoal, is hard, dense, smokeless, and free-burning. More than a hundred coals, including a wide range of bituminous coals and lignites, have been tried in the process, and apparently any coal can be used successfully. Construction of the commercial plant at Clinchfield, Va., was begun during the war as a government war project. It was finally completed and put into operation in June, 1920. Its capacity is between five and six hundred tons of raw coal per day. (Lantern slides showing construction of commercial plant, yields of by-products, etc.)

Fuel conservation, present and future: Horace C. Porter.

Some factors affecting the sulfur content of coke and gas in the carbonization of coal: Alfred R. Powell.

The distribution of the forms of sulfur in the coal bed: H. F. Yancey and Thomas Fraser. A study has been made of the quantitative distribution of the forms of sulfur, namely pyritic and organic sulfur, in coal as it occurs in the various sections or benches of the seam. About 120 samples were collected at twenty working places in three mines, one operating in the number six seam in southern Illinois, one in the number nine and the other in the number twelve bed in western Kentucky. At each face the seam was divided into from four to eight benches and was represented by a corresponding number of samples. Some of the samples were taken at places in the bed which showed the coal intergrown and interbedded with lenses, bands, and cat-faces of pyrite. The purpose of the work was to determine if a relation exists between pyritic and organic sulfur, and in case segregations or concentrations of organic sulfur were found to exist, to associate such occurrences with other impurities or specific recognizable conditions. The data secured indicate no definite and absolute relationship between quantitative amounts of pyritic and organic sulfur in a given bed or sample. Samples taken at five faces in one mine indicate, in the majority of instances, that an increase in pyritic sulfur is accompanied by a decrease in organic sulfur. This is not uniformly true and the data do not warrant any such generalization, except to say that high pyritic sulfur and visible segregations of iron pyrite are not indicative of high organic sulfur content.

Charles L. Parsons,
Secretary

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CONTENTS

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THE ORGANIZATION OF RESEARCH[1]

BEFORE delivering my paper I wish to confess that I find myself in a somewhat unpleasant predicament, for when I began it and even after sending its title to Professor Allee I was of the opinion that research might, perhaps, be amenable to organization, but after thinking the matter over I was compelled to reverse my opinion, with the result that what I shall say may strike some of you as painfully reactionary. Still I encouraged myself with the reflection that many others have written papers with misleading titles and that I might perhaps put much of the blame for the results on my confrères of Section F for conferring so signal an honor as its chairmanship on one of its tired old bisons from the taxonomic menagerie instead of on one of its fresh, young bulls from the Mendelian byre. I might say also, in further justification of myself, that I at least selected the most fashionable and exalted topic I could find, for you must all have observed that at the present time no word occurs with greater frequency and resonance in serious discourse than "organization." Everybody is so busy organizing something or inciting some one to organize something that the word's subtly concealed connotations of control and regulation appear to be overlooked. The purpose of organization is instrumental, as is shown by the derivation of the word, from "organon," a tool, or implement, which is

[1] Address of the retiring vice-president and chairman of Section F—Zoological Sciences—American Association for the Advancement of Science, Chicago, 1920.

in turn derived from "ergo," to work. It is one of those superb, rotund words which dazzle and hypnotize the uplifter and eventually come to express the peculiar spirit or tendency of a whole period.

These words, which for want of a better term I may call "highbrow," and the conceptions they embody, are so interesting that I will dwell on them for a moment. During the late Victorian period the most high-brow word was "progress." It disappeared and gave place to organization with the World War when we realized that the evolution of our race since the Neolithic Age was not nearly as substantial as we had imagined. Neither the Greeks nor the people of the Middle Ages seem to have had either of these words or their conceptions, though the Greeks, at least, did a fair amount of progressing and organizing. The Mediæval high-brow words were "chivalry" and "honor," the latter persisting down to the present day in Continental Europe in the German students' duelling code, as a living fossil, or what biologists would call a "relict." Schopenhauer[2] remarked that the duel and venereal diseases were the only contributions to culture the race had made since the classical period, overlooking the fact that the Greeks and the Japanese had their own high-brow words and institutions. Gilbert Murray[3] has shown that the word "aidos," which the Achæan chiefs of the Homeric age so solemnly uttered, was applied to a peculiar kind of chivalry, and the "bushido" of the Japanese was another similar though independent invention. All of these conceptions—progress, organization, chivalry, aidos, bushido—seem to start among the intellectual aristocracy and all imply a certain "noblesse-oblige," for there is no fun in continually exhorting others to progress unless you can keep up with the procession, or of organizing others unless you yearn to be organized yourself, just as there is no fun in getting up a duelling or bushido code unless you are willing to fight duels or commit harakiri whenever it is required by the rules of the game.

Of course, the vogue of "organization" was abnormally stimulated by the mobilization of armies and resources for the World War. We acquired the organizing habit with a vengeance and have not since had time to reflect that there may be things in the world that it would be a profanation to organize—courtship, *e.g.*—or not worth organizing—a vacuum, *e.g.*—or things that can not be organized, or if organizable, better left as they are—scientific research, perhaps.

There are at least three different types of organization. One of them we find ready to hand in individual animals and plants, in our own bodies and in animal colonies and societies, *i.e.*, in complexes which organize themselves both onto- and phylogenetically. This is a self-contained type of organization, requiring much time and energy for its consummation and though very intricate and profound still sufficiently plastic and adaptable to trade with time and the environment and to resist a considerable amont of thwarting and meddling. For obvious reasons this type appears to us to be so admirable that it influences all our conceptions of organi-

2 Zwei Dinge sind es hauptsächlich, welche den gesellschaftlichen Zustand der neuen Zeit von dem des Altertherms, zum Nachtheil des ersteren unterscheiden, indem sie demselben einen ernsten, finstern, sinistern Anstrich gegeben haben, von welchem frei das Alterthum heiter und unbefangen, wie der Morgen des Lebens, dastebt. Sie sind: das ritterliche Ehrenprincip und die venerische Krankheit—*par nobile fratrum!* Schopenhauer, "Parerga und Paralipomena," Ed. Frauenstädt, Vol. 5, 1888, p. 413.

3 "The Rise of the Greek Epic," 2d Ed. Oxford, Clarendon Press, 1911, pp. 103-112.

zation. If the Greeks had coined a word for organization—the nearest word, orgánosis, seems not to appear till the twelfth century—they would probably have applied it to a second type of cases, in which an agent organizes a complex as an engine for accomplishing certain results. In this sense Mr. Ford would be an organizer of motor cars and in such a sense theologians might speak of the Deity as organizing the universe. This is organization imposed on inorganic or at any rate alien materials. At the present day the word is not used in this sense, since the notion of life in the materials to be organized seems to be so essential. There is, however, a third type, which is intermediate between the two preceding, one in which certain elements of a living complex are permitted or delegated or arrogate to themselves the right to organize the remaining elements, as is seen in innumerable human organizations from a state, church or army to a band of robbers. This type of organization, can often be swiftly accomplished, especially if reinforced by the first type, but is necessarily more or less of an artefact and prone to easy and unexpected disintegration. We have this type in mind when we speak of the organization of scientific research, or investigation. It is evident, moreover, that the organization of research up to the present time has developed according to the first type, through a natural division of labor and inclination among investigators and by means of such cooperative *liaison* agencies as learned societies and publications. Even the most pessimistic among us must be lost in admiration at the results thus accomplished during the past few centuries. But the organizers feel that we have been moving too slowly and have been wasting too much time and effort—and they also feel, apparently, that natural, or organic organization of research, like that of the past, affords too little scope for the expression of those instincts of self-assertion and domination, which are so evidently associated with the accumulation of hormones in the older males of all mammals. These hormones commonly produce such an obfuscation of the intellect that even our mature biologists seldom realize that they are headed for the fate of the old rogue elephants and bulls, which, when they try to do too much organizing, are promptly and unceremoniously butted out of the herd by the youngsters.

The phrase "organization of research" is nonsense if we take "research" in its abstract sense, for an abstraction, of course, is one of the things that can not be organized. All we can mean by the term is the organization of the actual processes of research, or investigation, and since these processes are essentially nothing but the living, functioning investigators themselves, organization of research can mean only the organization of the investigators. It would seem desirable, therefore, before attempting such organization to make a behavioristic study of these creatures—either to catch and closely observe a number of them or to steal on them unawares while they are in the full ardor of research—in other words to investigate the investigators. Unfortunately no one has made such a study, which should, of course, precede the making of a card catalogue of the various species, subspecies, varieties, mutations and aberrations of investigators and the enumeration of their genes and chromosomes. And as the investigators themselves seem to be so busy that they have no time to scrutinize their own behavior, or if they do, are either too proud or too bashful to tell us what they find, I am compelled, for the sake of my argument, to attempt such a study and hence to make a brief excursion into psychology. As this

is one of the fields in which it is still possible to do a certain amount of loose thinking with impunity. I may hope to return sufficiently intact to proceed with the discussion.

It is often supposed that the investigator enters his laboratory full of instruments and glassware and proceeds, with the use of this equipment, his sense organs and his carefully controlled ratiocinative powers to excogitate the discoveries which our newspaper editors occasionally deign to distort for the benefit of the readers of their Sunday supplements. But every investigator who observes his own activities or those of other investigators knows that this is, to say the least, a very inadequate account of the process, and every psychologist knows that while the proper employment of the senses and the reasoning powers is extremely important, the real "drives" are the instincts, emotions and interests, or what some authors prefer to call in more anæmic terms, the propensities, conative tendencies, sentiments or dispositions. To the biologist, who takes a behavioristic view of the instincts, it is difficult to single out the various drives that initiate, determine and sustain such intricate activities as those leading to scientific discovery and invention, and the psychologists themselves are far from unanimous on this matter. The list submitted in the sequel is, therefore, merely an approximation to the true state of affairs, though it is probably adequate for the purpose I have in mind.

To merit the designation of human instincts, in the conventional sense, tendencies or dispositions must be innate and purposive, common to all the normal individuals of our species, less overlaid or camouflaged by habits and therefore more evident in the young than in the adult and represented by similar though more rudimentary tendencies in the higher mammals. Such instincts seem to be rather numerous and several of them are exhibited by the investigator in a highly specialized form or are at any rate evoked and conditioned by very specific objects or situations. We can recognize:

1. Curiosity, which seems to be clearly manifested in many mammals, like the cow which stares at us across the pasture, and in the open-mouthed wonder of the child. It is so characteristic not only of individuals but of whole peoples that the Germans often refer to it as a national peculiarity of the Saxons. In the investigator it is commonly insatiable and very intense, because restricted to certain objects and relations, particularly to the causal relations among phenomena. Its importance has been noticed by many writers. McDougall[4] says that in men in whom curiosity is innately strong, "it may become the main source of intellectual energy and effort; to its impulse we certainly owe most of the purely disinterested labors of the highest types of intellect. It must be regarded as one of the principal roots of both science and religion." It is perhaps worthy of note that "inquiry" is often used as a synonym of investigation, and that any problem is most naturally and most concisely stated in the form of an interrogatory sentence.

2. The hunting instinct, which is primarily nutritive in animals and remains so very largely in savages. In children and adults of civilized man it persists in the form of sport and the love of rapid movement in such intensity that it is leading to the extinction of our native faunas and an enormous development of the automobile industry, while in the investigators—the word itself means followers of an animal's spoor—such as zoologists, archeol-

4 "An Introduction to Social Psychology," Boston, Luce & Co., 1910, p. 59.

ogists and explorers it is too apparent to require discussion. It is not lacking, however, in other investigators, all of whom when too old or too lazy to hunt their accustomed prey in the open, delight to sit and hunt for the opinions of others and especially for confirmation of their own opinions, in comfortably heated libraries.

3. The acquisitive, collecting or hoarding instinct, also primarily nutritive in animals and savages, but modified in children and adults of civilized peoples, in whom it manifests itself in the most extraordinary form of amassing all sorts of objects, from newspaper clippings and cigar-bands to meerschaum pipes and shaving mugs. It is unnecessary to dwell on its truly monomaniacal manifestations among zoologists and botanists, who collect everything from mites to whales and from bacteria to sequoias. But even those who look down with contempt on the enthusiastic collectors of bird-lice or coprolites are themselves usually addicted to collecting so-called data or statistics. The significant difference between the mere magpie-like collector and the hamster-like investigator lies, of course, in the use made of the accumulated objects.

4. The instinct of workmanship, craftsmanship or contrivance, which also has its phylogenetic roots in the constructive activities of very many animals. In man it begins ontogenetically with the making of mud-pies and may lead to such achievements as the excavation of the Panama Canal or the construction of an airship. It is, as Veblen[5] and others have shown, an instinct of the greatest importance. In the investigator it is seen in the inventing of methods and devices and the construction of apparatus and hypotheses, and reaches its highest manifestations in flights of the creative imagination.

The four instincts I have been very briefly considering might be called individual to distinguish them from four others which are more deeply rooted in the social life of the investigator. These are:

5. Emulation. The decision as to whether this may be traced among animals to competition for food or for mates may be left to Jung and Freud and their respective disciples. According to William James,[6] emulation is "a very intense instinct, especially rife with young children or at least especially undisguised. Every one knows it. Nine tenths of the work of the world is done by it. We know that if we do not do the task some one else will do it and get the credit, so we do it." It is powerful and elaborately conditioned in investigators and perhaps the less said about it the better. The word "priority" will conjure up in your minds a sufficient number of emotionally toned ideas to meet the needs of this discussion.

6. What for lack of a better term I shall call the instinct of communication. It seems to have its roots in the behavior of those more or less gregarious or social animals, which apprise one another by signs or sounds of the presence of danger, of food or of certain sexual states. Its manifestations may be said to range from the chirping of crickets, tree frogs and birds to the invention of language and the effusions of poetry and music, both vocal and instrumental. In both the old and the young of our species it appears also as the by no means sex-limited impulse to gossip and divulge secrets, to communicate news and rumors, much information and no little misinformation. It urges the investigator to communicate the results of

5 "The Instinct of Workmanship," N. Y., B. W. Huebsch, 1918.

6 "The Principles of Psychology," N. Y., Holt & Co., Vol. 2, p. 409.

his activities to learned societies and to publish those results to the world or at least to a select coterie of specialists. The strength of this instinct might be tested by passing stringent laws forbidding certain investigators from attending scientific meetings or publishing anything for long periods of time or during their life-time or even posthumously. The results of such experimental repression might be illuminating but I refrain from speculating on their nature.

7. Closely connected with this instinct of communication is the craving for sympathy and appreciation so clearly exhibited by most highly social animals and so undisguisedly shown by children. Most investigators exhibit such a moderate development of this craving that they seem to be quite satisfied with the good opinion of the workers in their own specialties. But even if more appreciation were demanded the individual investigator would stand little chance of obtaining it, for investigators have become so numerous and the field of their labors has been so vastly expanded through their own enthusiastic efforts and so thickly overgrown with a dense crop of technicalities of their own sowing and cultivation, that most of them can be known only to those who are working in the same or adjoining furrows.

8. The instinct of cooperation—also very evident and of far-reaching significance in gregarious and social animals and manifested in the team-play of young human beings and the innumerable associations of adults. In many investigators this instinct seeems to be rather feeble but may still appear at least in the ambition to figure in the rôle of an honest hod-carrier in the erection of some small fragment of the great edifice of human knowledge. In others it may be sufficiently developed to constitute a powerful drive to the invention of labor-saving devices and machinery, methods of preventing disease and increasing longevity and mental and physical efficiency.

This list is probably incomplete, but I believe that it comprises at least the more important drives of the investigator. The special trend of his activities is, no doubt, further determined by his native capacities, but the psychological problem as to whether or not these also constitute drives, as Woodworth[7] maintains and McDougall[8] denies, I shall not attempt to discuss. The point I wish to emphasize is that the specific activities of the investigator depend primarily and preeminently on his instincts, emotions, interests and native endowments.

If we turn now to a survey of investigators in general we find that they can be divided into two classes, usually called theoretical and practical, or pure and applied. The term pure is, to say the least, somewhat priggish, since it seems to imply that its alternative is more or less contaminated, and theoretical and practical are unsatisfactory because all investigation is necessarily both. I prefer, therefore, to designate the two classes as discoverers and inventors, since the former are primarily interested in increasing our knowledge of our environment and of ourselves, the latter in increasing our power over our environment and ourselves. From the very nature of this distinction it follows that the discoverer pursues more general, more theoretical and therefore more remote aims, whereas the inventor, in the very broad sense in which I am using the term, busies himself with more special, more practical and therefore more immediate problems.

7 "Dynamic Psychology," N. Y., Columbia Univ. Press, 1918, pp. 66 *et seq.*

8 "Motives in the Light of Recent Discussion," *Mind*, 29, N. S., 1920, pp. 277–293.

As both types of investigation are equally essential to the fullest spiritual and economic exploitation of the universe, no society can attain to a high level of culture unless it provides impartially both for its discoverers and its inventors.

There is another classification of investigators which will be useful for the purposes of my argument—namely, into professionals and amateurs. I am, of course, using these words in their good sense, not with the evil connotations that have grown up around them. It is clear that both may suffer from certain disabilities, the professional from well-known guild restrictions, the amateur from lack of opportunity or equipment or of the lively interchange of ideas so necessary to the most fruitful type of investigation. Both, too, have their advantages, the professional in the support and advertisement of his guild-fellows, the amateur in the freedom to choose and delimit his own problems, to work on them in his own way and to publish when he sees fit. These distinctions did not escape that clever old fox, Samuel Butler, who says:[9]

> There is no excuse for amateur work being bad. Amateurs often excuse their shortcomings on the ground that they are not professionals, the professional could plead with greater justice that he is not an amateur. The professional has not, he might well say, the leisure and freedom from money anxieties which will let him devote himself to his art in singleness of heart, telling of things as he sees them without fear of what man shall say unto him; he must think not of what appears to him right and lovable but of what his patrons will think and of what the critics will tell his patrons to say they think; he has got to square every one all round and will assuredly fail to make his way unless he does this; if, then, he betrays his trust he does so under temptation. Whereas the amateur who works with no higher aim than that of immediate recognition betrays it from the vanity and wantonness of his spirit. The one is naughty because he is needy, the other from natural depravity. Besides the amateur can keep his work to himself, whereas the professional man must exhibit or starve.

Contrasting the professional and amateur, to the advantage of the latter, was also a favorite pastime with that irritable old bear, Schopenhauer.[10] He compared the professionals with dogs, the amateurs with wolves, but he was not always consistent zoologically, for he sometimes thought of the professionals as cattle, as *e.g.*, when he says:

> On the whole, the stall-feeding of our professorships is most suitable for ruminants, but those who receive their prey from the hands of Nature, live best in the open.

At present the terms professional and amateur seem to have fallen into disuse among scientists, for reasons that are not far to seek. We know that during the eighteenth and nineteenth centuries, when the books and apparatus necessary for the prosecution of research were so meager as to be within the reach of men of very moderate means, amateurs were able to do a vast amount of important work in all the departments of science. This was particularly true in England and America. In England we have a teacher of music, Wm. Herschel, making great discoveries in astronomy; a stone-cutter, Hugh Miller, in geology; a Nottingham cobbler, George Green, in mathematics; a grocer of Ightham, Harrison, and a jeweller of St. Leonards, W. J. L. Abbott, in archeology, and a country gentleman, Charles Darwin, in biology. There were men like John Hunter, Lyall, Wallace, Galton, Samuel Butler, Lubbock, Bates and a host of other eminent investigators, who really belonged to the class of amateurs. Till very recently whole sciences, such as taxonomy and

9 "The Notebooks of Samuel Butler." Edited by H. F. Jones. N. Y., E. P. Dutton & Co., 1917, p. 145.

10 *Loco citato*, Vol. 6, p. 519.

zoogeography, entomology and genetics were almost entirely in the hands of amateurs. Mendel was an amateur and all the wonderful varieties of our domestic animals and plants were developed, one might almost say invented, by amateurs. The change which has come over the situation is due to the great increase in our knowledge in more recent times and the exuberant growth of our universities, technical schools, museums and research institutions. These have made investigation more and more difficult for the amateur, especially in the inorganic sciences and in physiology, which now demand an exacting preparation and elaborate apparatus, although there are even at the present time a few eminent amateur astronomers and geologists. Amateurs still abound, nevertheless, in zoology and botany, in which it is still possible to carry on much valuable research with very simple equipment. There must be thousands of them, and nothing is more extraordinary than the ignorance of their work on the part of many of our university professionals. I could give a long list of men in the most diverse professions, lettercarriers, stage-coach drivers, hosiers, portrait-painters, engravers, parsons, priests, stockyard superintendents, engineers, bankers, country-grocers, country-doctors, army officers, mining prospectors, school teachers and clerks, whose researches have greatly enriched entomology and other departments of zoology. In such vast and complicated sciences as biology and archeology the work of the amateur is so much needed and so worthy of encouragement that we may regard it as one of the greatest defects of our educational system that a youth is ever able to leave the science courses of a high school or college and take up the humblest calling, without a fixed determination to fill at least a portion of his leisure hours with the joys of research.

The disuse of the words professional and amateur is also, no doubt, due to the fact that the two kinds of investigators can no longer be sharply distinguished. Not only are the biologists in our universities and museums frequently recruited from the ranks of the amateurs, but as investigators in those institutions many of them remain amateurs in spirit and merely exercise the teaching and curatorial professions because they can be more conveniently carried on in conjunction with research than more lucrative professions such as undertaking and plumbing. There is no reason to suppose that the number of amateur investigators may not greatly increase under a more favorable form of society. In the ideal commonwealth of the future it may not be in the least surprising to find that the communal furnace-man, after his four-hour day, is conducting elaborate investigations in paleobotany, and that the communal laundress is an acknowledged authority on colloidal chemistry.

Now if the preceding very hasty behavioristic account is accurate we must admit that it would be difficult to find a body of men more unfavorable for purposes of organization, even by a committee of their own class, than the investigators. Many reasons might be given in support of this statement, but I shall consider only the following four:

1. The activities of the investigator depend as we have seen, on an array of instincts, emotions and interests, many of which are so positive that their organization in the sense in which organizers are using the term, is out of the question. It is possible, of course, to overstimulate, repress, pervert and exploit instincts and they are undoubtedly able to organize

themselves by long processes of interplay, mutual adjustment and coordination, but even regulation of them *ab extra* is exceedingly difficult. In this matter the experience of the race in its age-long endeavors to regulate and organize such powerful drives as the sexual and parental instincts should be sufficiently illuminating, and the instincts of the typical inventor and discoverer seem to be every bit as imperative. The impossibility of organizing even a small body of investigators can be easily tested. Such bodies exist in our large universities, very small in comparison with the total number of investigators in the country, but large enough, if organized, to determine and control the whole policy of their respective institutions. But if any investigator attempts to organize such a body for such a purpose or for any other of mutual advantage, he will at once find his efforts frustrated or, at any rate circumvented, by a lot of individuals, turgid with peculiar instincts, emotions and purely personal interests and as blind to their collective interests as an equal number of soft-shell clams. Furthermore, it is important to note that the difficulties of organizing are greatly increased by the skeptical and critical attitude of mind which the investigator is bound to cultivate and the defective development of certain dispositions in his constitution, such as the gregarious instinct and the instinct of self-abasement and susceptibility to suggestion, propaganda and leadership, which render other men so prone or at least so accessible to social, religious and political organization.

2. Attempts at organizing investigators must fail because their highly specialized activities depend to such a great extent on their peculiar native aptitudes or capacities. The organizers are willing to admit that they are baffled by the geniuses, but these are dismissed as very rare birds, notwithstanding the fact that their influence on the trend of scientific research is out of all proportion to their numbers. The great majority of investigators appear on superficial acquaintance to be such commonplace, unassuming specimens of humanity that it would seem that they and society in general could only be greatly benefited by having their problems "assigned" and their investigative efforts directed, controlled and organized. This notion seems to me to be due to a singularly defective insight into the peculiar psychology of investigators. No one who has had long and intimate relations with these men can fail to be impressed with the extraordinary diversity of their aptitudes, and nothing is more evident than that these aptitudes must be permitted to express themselves not only with the greatest freedom, but even in the most whimsically personal manner. Nor can any one who is running a laboratory fail to notice that he can secure the fullest enthusiasm, devotion and team-play from all his men only on the condition that all considerations are absolutely subordinated to the ideals of research. He knows that some investigators can do their work best with a slow, uniform and apparently never-tiring motion, others with a ravenous, carnivore-like onrush, accompanied by an expenditure of vitality so magnificent that they have to loaf for a considerable period before they can store sufficient energy for another onslaught on their problem, and that there are many others whose investigative activities are of an intermediate and more evenly rhythmical type. Yet men of such diverse aptitudes and habits of work can be easily induced to live in harmony and accomplish much valuable work if any suggestion of such things as punctuality, punching time-clocks and other efficiency

and factory devices are most carefully avoided. So sensitive is the investigator to the need of giving expression to his capacities and of doing his work in his own way, that any one who is enough of a martinet to insist on introducing any of the devices to which I have alluded, will at once build up a defence reaction sufficiently powerful to vitiate or inhibit all the research activities of his laboratory. It is for this reason, I believe, that even the vague, tentative suggestions of the organizers are already creating a resentment or at any rate a resistance that would surprise no one who is not bent on behaving like the proverbial bull in a china shop.

3. Whatever may be the value of research to the individual investigator, it is certain that its only social value lies in the discoveries and inventions to which it may lead. The investigative genius may be defined as one who is in a chronic state of discovery or invention, whereas the ordinary investigator approximates genius more or less closely according to the frequency of his creative achievements. Now such essential achievements, both chronic and occasional, can not be included in any scheme of organization for they usually lie outside the purview of the investigator himself or depend on situations over which he has no control. Discovery and invention are in this sense fortuitous or accidental and also involve a time factor which is equally unpredictable and unorganizable. The investigator, if you will pardon my emphatic language, can only do his damnedest and hope that the new truth will deign to ascend from the subconscious or descend from the lap of the gods. After long and tedious observation or experiment and many disappointments he may or he may not find the discovery or invention flashing suddenly and more or less completely into consciousness or emerging from some happy constellation of events. The plant-physiologist Sachs once told me that his best ideas suddenly entered his mind in the morning while he was lacing his shoes or brushing his teeth. I have noticed in my own case that the few unimportant ideas that strike me as unlike those which ordinarily infest my waking consciousness emerge suddenly while I am passing a certain vacant lot on my morning trip to my laboratory. Not improbably my single cup of breakfast coffee may be a stimulus so timed that the reaction coincides with the vacant lot. I hasten to confess, however, that the outline of this paper was not picked up in a vacant lot, as its miscellaneous contents might lead you to suppose, but came to me, probably after prolonged subconscious incubation, while I was wondering how much coal I could save by using as an "Ersatz" the literature received during the past three years from that noble superorganization of superorganizers, the National Research Council.

4. I have dwelt on the amateurs, because they seem to me to form another insuperable obstacle to the organization of research, at least in the biological field, where they constitute a very large and important "bloc" of investigators. While one might be pardoned for supposing that some of the house-broken or domesticated investigators, who indulge in what is called "institutional" or "industrial" research might be organized after a fashion, it would be unpardonable to suppose that the wild, untamable amateurs would ever submit to such an indignity. These seem to be described as "solitary workers" in some of the literature I have received—why, I can not say. The amateur, as the word implies, is a lover, and all the world loves a lover, no matter how wild, or just because he is

wild. Certainly the many members of our numerous natural history, ornithological, entomological, malacological, botanical and mycological clubs, who hold monthly meetings and contribute modestly but effectively to the sum of our knowledge, regard themselves as anything but "solitary" workers. That designation would seem to be more applicable to some of the professionals in our universities and research institutions.

Of course, the organizer who has been stung by the efficiency bug, is troubled by all this diffuse and elusive activity and counters with the assertion that organization would save duplication of effort and direct it to problems of fundamental importance. This takes for granted a knowledge of the fundamental problems on the part of the organizer and a most enviable intuition of the means adapted to their solution, or, at any rate, seems to imply that working on fundamental problems means *eo ipso* making important discoveries and inventions. The contention that we must avoid duplication of effort must have had its origin in a machine shop or a canning plant, for it certainly never originated in the brain of any investigator worthy of the name. That the establishment of the simplest item of our knowledge not only requires duplication, but reduplication and re-reduplication of effort, is too obvious to require discussion, as is also the fact that we always regard the agreement in the results of two or more investigators working independently as presumptive evidence of truth. I would similarly pass over the further implication in the arguments of the organizers, that the only value of an investigator's work lies in the scientific data and conclusions which it contains, and that we are not concerned with its unconscious revelations of habits of thought, personality, etc. The perusal of the works of the great amateur entomologists, Réaumur and Fabre, might be recommended for those whose minds are in such a ligneous, arenaceous or argillaceous condition.

The suggestion that scientific research may be advantageously organized naturally leads one to consider those other great human activities, religion and art, which are also bound up with powerful instincts, emotions and interests. Certainly religion, especially in the form of dogma and ritual, has been so superbly organized *semper ubique et omnibus*, since it first arose in the totemism, taboo and magic of our savage ancestors, that it would seem to constitute a wonderful field for the study of both the blessings and curses of organization. It is, in fact, a field in which organization could be readily introduced and maintained owing to the proneness of so many human beings to suggestibility, credulity, the gregarious instinct, the instincts of self-abasement and fear, and the sentiments of awe and reverence—all of which, be it noted, are singularly feeble or defective in the investigator. The same conclusion would seem to follow from the very different view of some of the Freudians who state that all religions are permeated by a subterranean feeling of guilt and that "this absolutely unfailing presence of the feeling of guilt shows us that the whole structure of religion is erected on a foundation of repression of instinct."[11] That the perfection of organization so characteristic of religion may have been beneficent in other times may be admitted, but the more nearly perfect an organization, the less it is able to adapt itself to changing conditions, and the World War has disclosed to all thinking men the same kind of hopeless, resourceless

[11] *Cf.* O. Rank and H. Sachs, "The Significance of Psycho-analysis for the Mental Sciences." Transl. by C. R. Payne. Nervous and Mental Disease Monographs, No. 23. N. Y., 1916, p. 71.

overspecialization in our ecclesiastical organizations as that with which the biologist is so familiar in archaic, moribund and actually extinct species. At the present time the Church seems to be about as well adapted to piloting the great forces which are impelling society as is a two-toed sloth to piloting an airplane or a manatee the Twentieth Century Limited. Like the Edentate and the Sirenian the Church exhibits such feebleness of volition and muscular tonus and such a low ebb of creative energy, that one is inclined to find a modicum of truth in the aphorism which H. G. Wells saw posted by the bolsheviki on one of the houses in Moscow: "Religion is the opium of the people."

What a different picture is presented by that other great field of human activity, in which the instinct of workmanship and the creative imagination attain their finest and most unrestrained expression—the field of art! Its very life seems to depend on freedom from all imposed organization. Hence its plasticity and adaptability in all ages and places, its resilience and prompt resurgence after periods of conventionalization, or overspecialization. Unlike the religious person who seems always to be mistrusting his instincts, or the scientific investigator who is so sophisticated that he ignores them, the artist takes them to his bosom, so to speak, and in all his works tries to persuade the rest of the world to do the same. He thus becomes the ally of creative Nature herself and while himself capable of such control and restraint as are demanded in the harmonious execution of his work, quickly resents the slightest suggestion of restraint or control from the outside. This is so well known that one would find it more entertaining than informing to hear the comments of a lot of painters, sculptors, composers, poets, novelists and actors—and especially of a lot of actresses or prime donne—if some National Art Council had the temerity to suggest that their work could be greatly improved by organization.

The history of science and philosophy is not without significance in connection with the attempts of modern organizers. It is well known that both, after their twin-birth and brilliant childhood among the Greeks, lived through a kind of stupid Babylonian captivity as hand-maidens to the Mediæval Church, which had been so successful in organizing itself that it naturally tried to organize everything else. But science turned out to be such an obstreperous and incorrigible tomboy that she long since regained her freedom, and philosophy, though she had been treated with more consideration, and may still occasionally flirt, no longer, outside of our Jesuit colleges at least, sits down to spoon with theology as she did in the days of St. Thomas of Aquin.

Times have changed so greatly that at present we even have eminent amateurs, like the Rev. Erich Wasmann, S.J., who vie with Haeckel in the boldness of their evolutionary speculations. Scientific research is no longer concerned with the Church but with the two great forces which are contending for the mastery of the modern world, labor and capital. The present plight of the Russian investigators shows us, perhaps, what we may expect when certain communistic ideals of labor are put into practise, and Veblen's account of the evolution by atrophy of the creative artisan of former centuries into the modern factory operative, whose life has been reduced by capital, machinery and efficiency experts to one long hideous routine in some overspecialized task, shows us, perhaps, what we may expect when nothing but money talks.

Even if the investigator could hold aloof and adopt a policy of watchful waiting, till the world is controlled by either labor or capital or, as seems more probable, by some compromise between them, he would still be in an unfortunate position. Since both labor and capital are primarily concerned with production, we should expect both to center their interests on applied research, or invention and to neglect research which is fundamentally concerned with discovery. This would be unfortunate, because the two kinds of research can be most fruitful only in symbiosis, for the neglect of discovery must lead to impoverishment of the theoretical resources of the inventor, and purely theoretical research strongly tends to become socially ineffective. We have as yet, I believe, no concise information in regard to labor's attitude to so-called pure research. The attitude of the capitalist, or business man seems to be much more definite. His activities, like those of the investigator, are bound up with certain powerful, highly conditioned instincts, emotions and interests, some of which have been elucidated by Taussig.[12] He believes that the business man is driven mainly by the acquisitive instinct, centered of course on pecuniary profits, the instinct of domination or predation, the instinct of emulation, in the special form of social emulation, and the instinct of devotion or altruism. Undoubtedly we must recognize also the importance of the instinct of workship as a powerful drive in many eminent business men, but both it and the instinct of devotion are, of course, apt to be directed to practical matters or to those which yield immediate returns, such as philanthropy, charity, medicine, etc. Apart from certain notable exceptions, business men may, therefore, be expected to favor invention and to take little interest in discovery, except when it relates to natural resources capable of exploitation.

[12] "Inventors and Money-Makers," N. Y., Macmillan Co., 1915.

These considerations lead me to the opinion that so long as our present society endures adequate financial and other support for research in its most comprehensive form will be forthcoming only after the general community has thoroughly grasped the fact that of the four great fields of human endeavor, science, art, religion and philosophy, science is of the most overwhelming social value in the sense that the welfare of every individual, physically, mentally and morally, absolutely depends on its developments, or in other words, on scientific research. To saturate the general public with this conviction is a formidable task and one that can be accomplished only by a slow process of education.

There is also another aspect of the subject which I can best make clear by returning to that form of organization which we observe inhering in individual animals and plants and in the societies of the former. Occasionally we find such organisms so highly integrated, differentiated or specialized as seriously to impair their powers of adaptation. When such a condition is reached, the organism either persists without phylogenetic change, if its environment remains stable, or soon becomes extinct, if its environment changes. Most organisms, however, retain a lot of relatively unorganized, or more or less generalized structures and functions as reserves for prospective adjustments to the changing environment. Our own bodies still contain many such primitive elements, like the white blood corpuscles, the undifferentiated connective tissue, dermal and glandular cells, and in larval insects we find even undifferentiated nerve cells. And we all carry with

us in our subconscious a great reservoir of very primitive instincts and tendencies, many of which are as archaic as those of our Palæolithic and anthropoid ancestors. This whole relatively undifferentiated and imperfectly organized equipment must be of the greatest value as a source of future adaptations.

We are also beginning to see that as civilization progresses it is necessary to maintain a certain number of our activities in a primitive, unorganized condition and for their exercise to set aside hours of leisure and relaxation, vacations and holidays, so that we can escape from the organized routine of our existence. And as the surface of the planet becomes more and more densely covered with its human populations, it becomes increasingly necessary to retain portions of it in a wild state, *i.e.*, free from the organizing mania of man, as national and city parks or reservations to which we can escape during our holidays from the administrators, organizers and efficiency experts and everything they stand for and return to a Nature that really understands the business of organization. Why may we not regard scientific research, artistic creation, religious contemplation and philosophic speculation as the corresponding reservations of the mind, great world parks to which man must resort to escape from the deadening, overspecializing routine of his habits, mores and occupations and enjoy veritable creative holidays of the spirit? These world parks are in my opinion the best substitute we are ever likely to have for the old theological Heaven, and they have the great advantage that some of us are privileged to return from them with discoveries and inventions to lighten the mental and physical burdens of those whose inclinations or limitations leave them embedded in routine. This is the meaning of that stanza in the witch's song of Faust:

> The lofty skill
> Of Science, still
> From all men deeply hidden!
> Who takes no thought,
> To him 'tis brought,
> 'Tis given unsought, unbidden![13]

Like other members of society, the scientist, artist and philosopher must always devote considerable time and energy to routine occupations, for their lives, with very rare exceptions, are not completely absorbed in research, speculation and creative activity. They might therefore be expected to react rather unpleasantly to any suggestion of meddling with those occupations in which they feel that they can express their personalities with the greatest freedom and the greatest satisfaction to themselves if not to others. It seems to me that it can only be due to the modesty or indifference of scientific investigators that they have failed to voice their opinions of the organizers. The only utterances I have seen are an admirable paper by Professor Sumner[14] and in another field, that of social theory, a few paragraphs by G. D. H. Cole.[15] I will end my paper with these paragraphs, because they express so concisely the conclusions I have reached from a different point of view:

> First of all, it is necessary to rid ourselves once and for all of the notion that organization is in itself a good thing. It is very easy to fall into the notion that growing complexity is a sign of progress, and that the expanding organization of Society is a sign of the coming of the Cooperative Commonwealth. A constantly growing measure of cooperation among men is no doubt the greatest

[13] Goethe's "Faust." Trans. by Bayard Taylor. N. Y., Houghton Mifflin Co., Vol. 1, 1912.

[14] "Some Perils which Confront us as Scientists," *Scient. Monthly*, March, 1919, pp. 258–274.

[15] "Social Theory," N. Y., Stokes Co., 1920, p. 185.

social need of our day; but cooperation has its unorganized as well as its organized forms, and certainly the unorganized cooperation of men, based on a sheer feeling of community, is not less valuable than organized cooperation, which may or may not have this feeling of community behind it. It is easier to do most things with organization than without; but organization is to a great extent only the scaffolding without which we should find the temple of human cooperation too difficult to build.

To say this is not to decry organization; it is only to refrain from worshiping it. Organization is a marvelous instrument through which we every day accomplish all manner of achievements which would be inconceivable without it; but it is none the less better to do a thing without organization if we can, or with the minimum of organization that is necessary. For all organization, as we have seen, necessarily carries with it an irreducible minimum of distortion of human purpose; it always comes down to some extent, to letting other people do things for us instead of doing them ourselves, to allowing, in some measures, the wills of "representatives" to be substituted for our own wills. Thus while it makes possible in one way a vast expansion of the field of self-expression that is open to the individual, it also in another way distorts that expression and makes it not completely the individual's own.

In complex modern communities there are so many things that must be organized that it becomes more than ever important to preserve from organization that sphere in which it adds least to, and is apt to detract most from, our field of self-expression—the sphere of personal relationships and personal conduct.

WILLIAM MORTON WHEELER

NELSON R. WOOD

FOR many years I knew the late Mr. Nelson R. Wood, who suddenly died in Washington on November eighth, and during all those years he was employed in the taxidermical department of the United States National Museum. As a scientific and artistic taxidermist he had not a single equal in this country, and I personally never knew of his peer anywhere in the world. Birds were ever the special objects of his skill, and to the mounting of them for museum exhibition the greater part of his life was almost daily devoted. While a consummate master with birds of all groups, certain families of them were his especial favorites, and these he preserved in a manner so perfect that they appeared to need but the instillation of life to have them go their way as they did in nature when alive. The forms particularly referred to were the game birds, pigeons, and fowls of all descriptions, and many of these, together with a host of others, are now on exhibition in the cases at the United States National Museum, where they will probably be viewed for many generations to come.

It has been my privilege to publish, in various works both here and abroad, over a hundred of Mr. Wood's mounted specimens of birds and many species—not only those of this country, but of all the Americas, Australia, and other parts of the Old World as well. They have ever been received and spoken of with more than marked approval and highly praised, as they well deserved to be.

It is not easy to estimate the far-reaching loss the death of such a man is to a great museum, where high-class taxidermical work is so essential and so constantly in demand. In the entire history of the scientific art of taxidermy in America, no one has ever left such mounted specimens of game birds, pigeons, and domesticated fowls as Mr. Wood, while in the case of many of the passerine types he was equally skilful. Only a short time before his death he mounted several specimens of crows and jays—single pieces—and the work is the wonder of all who see it. One of our common Crow in particular is the most life-like thing of the kind that one may well imagine; it represents the height of the science in regard to modern taxidermy, which passed, only within comparatively recent time, from the antiquated methods of "stuffing" birds to the practise of imperishably preserving them in their natural poses.

Mr. Wood gained his knowledge of the normal attitudes of birds in nature through his life-long study of them in their various habitats. More than this—he had so skilfully

mastered the imitation of the notes and calls of a large number of birds of many species, both wild and domesticated ones, that it was truly wonderful to witness some of his achievements along such lines. When a flock of crows was flying far overhead, I have seen him call them all down, alighting all about him, all giving vent to those notes they are accustomed to give when one of their kind is in trouble and cawing for help. It was remarkable to note the effect his marvelous imitations in this way produced on many kinds of birds in domestication as well as those in nature.

R. W. Shufeldt

FRANZ STEINDACHNER

Franz Steindachner, for many years intendant or chief director of the Hofmuseum at Vienna, died on December 10, 1919, at the advanced age of 85. His death was due directly to the inability of the Austrian Museum to secure coal to warm any of its offices.

Steindachner, a student and friend of Agassiz, spent some time at Harvard, about 1870, later collecting fishes in California and Brazil. His first systematic paper on the fossil fishes of Austria was published in 1859. From that time until 1914 when the war wrecked his nation, his memoirs on fishes, living and fossil, some 440 in all, appeared with great regularity. These were always carefully prepared and finely illustrated by the stone engravings of his most excellent artist, Edward Konopicky.

His last series of papers in quarto dealing with certain fishes of Brazil passed into the hands of the British censor, an obstacle from which but one copy has yet come across.

Steindachner conferred his attention to faunal work. especially to exact definition of genera and species. The larger combinations he left to less experienced investigators on the principle laid down by Linnæus. "*Tyro novit classes; magister fit species.*" Within the field as thus limited, no German systematist in vertebrate zoology has stood in the class with him.

When the Imperial government razed the fortifications of old Vienna, the property on the street thus opened, the "Burgring," was sold and with the proceeds three imperial public buildings were erected, the Opera House, Library and the Museum of Natural History. The last was long since placed in Steindachner's charge, but with a wholly inadequate force, and with little provision for extension. In the fishes, Steindachner had the services of an artist and a preparator, but had to do all the identification and labelling himself, and to pay from his own means for all specimens he felt it necessary to buy.

In his devotion to his work, he never married and when I visited him in 1910 he occupied humble lodgings in a stone annex to the museum, cared for only by an elderly housekeeper. To the general public he was known as a "*Bekanter Fischkenner.*" To his colleagues he was one of the most trustworthy and most devoted lovers of knowledge for its own sake. Among the tragedies of the great war nothing is more disheartening than its smothering effect on European science, one feature of which has been the death of this great master in faunal zoology.

David Starr Jordan

SCIENTIFIC EVENTS

SIGMA XI AT THE UNIVERSITY OF PENNSYLVANIA

The society of the Sigma Xi of the university will hold its next meeting in the medical laboratory on Wednesday evening, January 19. The subject for discussion will be "Wheat; a Study in the World's Food Supply." Dr. Alonzo E. Taylor, professor of physiologial chemistry, will open the discussion. Dr. Taylor was one of the advisers of the U. S. Department of Agriculture during the war and who made several food surveys in Europe for the State Department. After he has made a survey of the subject the discussion will be continued by Dr. Clyde L. King, of the Wharton School faculty, who will speak on the situation in the United States. Dr. Ernest M. Patterson, also of the Wharton

School faculty, will discuss the situation in Europe.

Three other meetings are scheduled during the remainder of the college year. On Wednesday, March 9, a meeting will be held in the Law School and the subject for discussion will be "Statistical Methods." On Wednesday, May 25, the society will meet in the botanic gardens and discuss "Fertile Border Fields in Scientific Research." The final meeting of the year will be a joint meeting with Phi Betta Kappa in Houston Hall, on Monday, June 13.

The last meeting of the society was held on Tuesday, November 23, at the Art Alliance, 1823 Walnut Street. At that time there was an illustrated lecture on "Modern American illustrations," by Thornton Oakley, '06. Dr. Erwin F. Faber, the illustrator for the medical department, spoke on "Scientific illustration." Dr. Clarence E. McClung, head of the zological department spoke on "What a scientific illustration should contain." Dr. McClung was recently made national president of the Sigma Xi for a period of two years. Dr. McClung was on leave of absence from the university last year engaged in some special investigation for the government.

FIRST MEETING OF THE CELLULOSE SECTION AMERICAN CHEMICAL SOCIETY

AT the cellulose symposium held by the Industrial Division of the American Chemical Society at the meeting in Chicago last September, it was voted to form a permanent Cellulose Section. Following the meeting the necessary steps for organization were taken, and President Noyes appointed Professor Harold Hibbert, of Yale University, chairman of the new section with Gustavus J. Esselen, Jr., secretary. One of the objects of the section is to provide an opportunity for those interested in the practical application of cellulose to get together with those concerned with the more strictly scientific aspects of cellulose chemistry and to afford an opportunity for discussion which should prove mutually helpful.

An interesting program is being arranged for the first meeting of the new section in connection with the meeting of the American Chemical Society in Rochester, N. Y., beginning on April 26. Those having papers which they would like to present before the section are requested to send title and abstract before April first to the secretary, who may be addressed, care Arthur D. Little, Inc., 30 Charles River Road, Cambridge, 39, Massachusetts.

G. J. ESSELN, JR.,
Secretary

FORESTRY LEGISLATION BY THE NATIONAL GOVERNMENT

HEARINGS on the national forestry program bill, which calls for the expenditure of $11,000,000 a year for the protection and development of forests, were begun on January 7, before the subcommittee on appropriations of which Representative Anderson is chairman.

Newspaper publishers, paper manufactures, lumbermen, timberland owners wood-using industries, the United States Forest Service and the American Forestry Association were represented.

One million dollars a year for cooperating with the states in protecting the forests from fire, and $10,000,000 a year for securing additional forest land for the government is being asked as a forward step in the endeavor to secure sufficient lumber and paper pulp for future needs.

R. S. Kellogg, chairman of the national forest program committee, has made the following statement:

> This is a paper age, and in the United States, at least, a newspaper age. From an annual consumption of three pounds of news print paper per capita in 1880 we have gone to thirty-five pounds in 1920. The news print paper produced in the United States and Canada this year, if put in the form of a standard roll seventy-three inches wide, such as is used by many of the large newspapers, would unwind 13,000,000 miles. Our daily papers have a circulation in excess of 28,000,000 copies, and there are more than 100 dailies between the Atlantic and Pacific whose circulation exceeds 100,000 copies, and some of them have several times that number.

The proposed legislation has been indorsed by the National Lumber Manufacturers' Asso-

ciation, the American Forestry Association, American Newspaper Publishers' Association, National Wholesale Lumber Dealers' Association, Southern Pine Association, Western Forestry and Conservation Association, American Paper and Pulp Association, United States Forest Service, Society for the Protection of New Hampshire Forests, national forest fire protection committee.

RESOLUTIONS OF THE NATIONAL RESEARCH COUNCIL ON THE DEATH OF HENRY A. BUMSTEAD

As has been recorded in Science Dr. Henry A. Bumstead, professor of physics and director of the Sloane Physical Laboratory at Yale University, and for the past half year on leave from the university as chairman of the National Research Council of Washington, D. C., died suddenly on the train on the night of December 31, while returning from Chicago, where he had been in attendance at the meetings of the American Association for the Advancement of Science and affiliated socieies. The following resolution was unanimously adopted at a special meeting of the Interim Committee of the National Research Council, held on January 3, 1921:

Resolved, That the National Research Council learns of the death of Dr. Henry A. Bumstead, chairman of the council, with great sorrow and profound sense of loss. Dr. Bumstead in his association with the council had revealed to its officers and members not only a high capacity for administration, and a most loyal fidelity to the aims and work of the council, but also a sweetness of disposition and personal attractiveness which had won for him the devoted and affectionate regard of all of his colleagues in the council. In his death the council and the scientific world lose a man of most eminent attainments, highest character, and lovable personality.

The National Research Council extends to the bereaved wife and family its deepest sympathy and condolence and wishes to express to them its full appreciation of the great value of the services which Dr. Bumstead rendered it in the period of his association with it and the great loss which it suffers by his untimely death. But may we all remember that "that life is long that answers life's great ends."

SCIENTIFIC NOTES AND NEWS

Dr. Edgar Fahs Smith, former provost of the University of Pennsylvania, has been elected president of the American Chemical Society. Dr. Smith was president of the society in 1898. Announcement is also made that the ballots of the 15,500 members of the society resulted in the election of the following other officers: Directors, George D. Rosengarten, of Philadelphia, and Dr. Henry P. Talbot, of the Massachusetts Institute of Technology. Councilors, Dr. Carl L. Alsberg, of the Bureau of Chemistry; Dr. Allen Rogers, of Pratt Institute; Dr. Lauder W. Jones, of Princeton University, and Harrison E. Howe, of the National Research Council.

Professor C. E. Allen, of the department of botany of the University of Wisconsin, was elected president of the Botanical Society of America at the recent meeting in Chicago. He was also named editor-in-chief of *The American Journal of Botany.*

The Perkin medal of the American Section of the Society of Chemical Industry has been awarded to Dr. Willis R. Whitney, research director of the General Electric Company.

A distinguished service medal was awarded at the annual meeting of Gamma Sigma Delta, honorary agricultural society, held in Chicago, to Professor Stephen M. Babcock, inventor of the Babcock milk test and professor emeritus of agricultural chemistry at the University of Wisconsin. Professor Babcock was also made an honorary member of the organization.

Major Lawrence Martin, the Gilman Memorial lecturer in Geography at Johns Hopkins University for 1920–21, has been demobilized after three and one half years' service in the United States Army, and has entered the State Department in Washington. By order of the secretary of war, after selection by General Pershing and a board of officers, Major Martin has been placed on the General Staff eligible list.

Professor Edward S. Morse, of Peabody Academy and Boston Museum of Fine Arts, has been elected an honorary member of the East Asiatic Society.

MR. PHILIP AINSWORTH MEANS, appointed to the directorship of the Museo Nacional de Arqueología in Lima, Peru, assumed office in November.

DR. ROBERT CUSHMAN MURPHY, for ten years a member of the staff of The Brooklyn Museum, and curator of the department of natural science since April, 1917, has resigned in order to accept the position of associate curator of ornithology in The American Museum of Natural History. In his new work the greater part of his time will be devoted to a study of marine birds. The work will include both the preparation of reports upon the museum's present collections and the carrying out of field investigations in the south Pacific.

DR. E. J. BUTLER, lately imperial mycologist of the Agricultural Research Institute, Pusa (India), has been appointed director of the Imperial Bureau of Mycology, and can be addressed at 17, Kew Green, Kew, Surrey, England.

MR. CHARLES A. FORT, research chemist of the General Electric Co., of Pittsfield, Mass., has become chief chemist for the Forest Products Chemical Co., of Memphis, Tenn.

DR. HENRY H. RUSBY, dean of the school of pharmacy of Columbia University, will lead an exploration party which will leave in the early spring for the unexplored upper basin of the Amazon River. Among those accompanying him will be Professor Edward Kremers, of the University of Wisconsin, and Professor A. H. Gill, of the Massachusetts Institute of Technology, who will investigate seed and volatile oils.

DR. LOUISE PEARCE, of the scientific staff of the Rockefeller Institute, has returned from several months' stay in the Belgian Congo, where she went in order to study the treatment of African sleeping sickness with Tryparsamide (sodium salt of N-Phenylglycinamide-p-arsonic acid) prepared at the Rockefeller Institute. While returning through Brussels she was decorated with the order of the Crown, and her companion, Miss Elizabeth D. Bowen, with the order of Leopold II., by the king of the Belgians.

DR. T. C. LYSTER of the Rockefeller Foundation has gone to Mexico to make some observation on the present epidemic of yellow fever and offer the asistance of the foundation in the campaign for the eradication of the disease. The president of Mexico has accepted this offer and Dr. Lyster will return later in January to begin the campaign, the plans for which were submitted by him and are now being considered by the department of public health.

DR. MARTIN H. FISCHER, professor of physiology at the University of Cincinnati, has been granted a three months leave of absence, in order that he may accept an invitation to lecture on his researches in colloid chemistry at the Universities of Amsterdam and Utrecht. He is now in Holland.

DR. L. EMMETT HOLT, of Columbia University, has been appointed Lane medical lecturer for the year 1921. The lectures will be delivered at the medical school of Stanford University, San Francisco, during the week beginning November 28. on the general subject of growth and nutrition.

DR. ROBERT B. SOSMAN, of the Bureau of Standards, delivered on January 15 the address of the retiring president of the Philosophical Society of Washington on "The Distribution of Scientific Information."

DR. VERNON KELLOGG, permanent secretary of the National Research Council, is giving three lectures this month at Brown University on the Charles K. Colver Foundation. The subject of the lectures is "Human Life as the Biologist sees it." The dates are January 10, 17, and 24. The lectures will be published in book form by Houghton, Mifflin Company.

PROFESSOR HERMANN J. JORDAN, 19 Frans Halsstraat, Utrecht, Holland. who is writing a book on comparative physiology, desires especially the papers of American physiologists and experimental zoologists, and would be grateful to authors who may favor him with their publications.

THE Technical High School at Brünn, Czecko-Slovakia, desires to raise a fund in

honor of Ernest Mach, who was born in that neighborhood. Professor Mach's researches in physics and psychology have given him worldwide reputation. The purpose of the fund is to award a prize for an essay, dealing with the subjects of his interest. Subscribers may send contributions directly to Dr. Emil Waelsch at the address given.

The stated meeting of the New York Academy of Medicine, on January 6, was held in association with the Society for Experimental Biology and Medicine and the Harvey Society as a tribute of appreciation to the life and services of Dr. Samuel James Meltzer. Memorial addresses were made by Drs. George B. Wallace, Phoebus A. Levene, William H. Howell, Graham Lusk, and William H. Welch.

Dr. Edward J. Nolan, librarian of The Academy of Natural Sciences of Philadelphia, died on January 7, 1921. Dr. Nolan was connected with the academy from 1862 until the time of his death, having served during the greater part of that time as recording secretary, librarian and editor of the publications of the academy. At the meeting of November 16, 1920, the academy designated him as recording secretary emeritus, in recognition of his long and faithful service to the institution.

Italo Giglioli, professor of agriculture at Portici and Pisa, known for his work in agricultural chemistry, has died at the age of sixty-eight years.

We learn from *Nature* that Charles A. Sadler, who graduated from the University of Liverpool in 1905 and was the author of contributions on X-ray and other radiations, died on December 5.

The annual general meeting of the American Philosophical Society will be held on April 21, 22 and 23, 1921, beginning at 2 P.M., on Thursday, April 21.

The Honorable Chase S. Osborn, of Sault de Sainte Marie, Michigan, ex-governor of the state and former regent of the state university, has made a gift of $5,000 to the department of geology of the university, to provide for an expedition by Professor William H. Hobbs to study the evolution of mountains and continents. Dr. Hobbs has been granted leave of absence for the academic year 1921–1922 and will sail from San Francisco in July on a trip which will take him around the world. Governor Osborn is cooperating to raise an endowment fund which will provide for future expeditions by the geological department.

Professor Otto A. Reinking, professor of plant pathology of the college of agriculture, University of the Philippines. Los Baños, Laguna. Philippine Islands, returned to the Philippine Islands after an extended trip in Southern China, French Indo China, Siam, and the Federated Malay States. The trip was made possible through the cooperation of the division of crop physiology and breeding investigations of the Bureau of Plant Industry, Washington, D. C., with the University of the Philippines. The primary object of the trip was the study of citrus diseases in the various countries and the collection and study of the Siam seedless pummelo. Bud wood and plants of the famous Siam seedless pummelo were successfully introduced into the Philippines and also into the United States. Last year a similar trip was made by Professor Reinking for the United States and the Philippine governments. On this trip a study was made of the citrus diseases in Southern China and Formosa. Extensive collections were made.

We learn from the *British Medical Journal* that a complete scheme for the establishment of a school of tropical medicine and research in Parel, Bombay, has been submitted for the sanction of the British Secretary of State. and it is hoped that it will be opened at an early date and afford opportunities for postgraduate instruction to students from all parts of the world. A medical college will be established in association with King Edward's Memorial Hospital in Parel, the foundation stone of which will be laid this month.

A prize has been endowed in the name of Dr. Paul Legendre at the Société médicale des

hôpitaux de Paris to confer 3,000 francs every third year on the best work on the ethical and social aspects of the medical profession, published or presented during the preceding years, or for the best competing articles presented on a special topic. The first prize will be awarded in December, 1923, and a topic has been selected for this competition, namely, "A statistical and critical study of the French civilian and military medical and surgical rôle during the war, 1914–1918, and the resulting consequences for physicians and conclusions for the future."

PROFESSOR AND MRS. JEREMIAH W. JENKS have deeded property on the east shore of Cayuga Lake to Cornell University for the use of the department of biology. Boats, kept in the boathouse which comes with the property, will be available for collecting the specimens in which the end of the lake and the marshes near it abound.

THE zoology department of the University of Texas is the recipient of a gift of $500 from Mr. H. A. Wroe, member of the board of regents for the study of the physiology of reproduction in the opossum under Professor Carl Hartman.

UNIVERSITY AND EDUCATIONAL NEWS

A COLLEGE of engineering has been established at Cornell University to consist of the Sibley School of Mechanical Engineering, the School of Civil Engineering, and the School of Electrical Engineering. Professor Dexter S. Kimball has been appointed dean of the newly created engineering college and as directors of the work in the three schools, Herman Diederichs, mechanical engineering; Fred Asa Barnes, civil engineering, and Alexander M. Gray, electrical engineering have been appointed. Dean A. W. Smith, who has for many years had charge of Sibley College, and who is now acting president of the university, and Dean E. E. Haskell of the present college of civil engineering, have sabbatical leave next term, and retire from active service in June of this year.

THE resignation of Professor Russell H. Chittenden, of Yale University, from the chairmanship of the department of physiology, physiological chemistry and bacteriology has been accepted, and Professor Lafayette B. Mendel has been appointed his successor.

DR. H. B. LATIMER, who has been in charge of the courses in anatomy in the department of zoology of the University of Nebraska, has been granted a leave of absence for the current year to carry on research in anatomy at the University of Minnesota. His work is being taken by Mr. Daniel S. Brazda. Dr. E. B. Powers has also been added to the staff of the department taking the field of animal ecology.

DR. C. B. CLEVENGER has resigned an instructorship in the department of chemistry, University of Wisconsin, to accept a professorship of agricultural chemistry and head of the department of chemistry of the Manitoba Agricultural College.

DR. HENRY S. HOUGHTON, a graduate of Ohio State University and the Johns Hopkins Medical School, who has passed the last fifteen years in China, has been appointed director of the Peking Union Medical College.

DISCUSSION AND CORRESPONDENCE

NATURAL AREAS AND BIOLOGICAL SCIENCE

WITH the increasing activities in biological science there has been a correspondingly increased demand for the preservation of areas on which the fauna and flora may be found undisturbed by outside agencies. Workers in the various lines of ecology and genetics are particularly interested in these natural areas; the Ecological Society, several State Academies of Science, and other scientific organizations, are urging the reservation of areas suitable for study. Laboratory experiments under controlled conditions, however essential, can not replace field observation. In fact, the greater the amount of laboratory experimentation, the greater the need of natural areas—for laboratory work and field studies must go hand in hand and supplement each other; neither is sufficient unto itself.

The largest of our natural areas are in the National Parks and National Monuments. Efforts to secure the reservation of additional lands would fail of their purpose if, at the same time, the National Parks were not kept intact.

With the growing development of the country, the pressure upon the National Parks is constantly increasing. There have been a number of attempts recently to open these parks to some form or other of commercial use. The latest dangers are: First, the inclusion of the parks in the Water Power Bill, thus permitting the commission to grant permits for constructing in the National Parks and National Monuments, reservoirs, irrigation ditches, power plants and power lines; Second, the Smith bill, H.R. 12, 466, turning over 8,000 acres in one of the most beautiful parts of the Yellowstone Park to Idaho irrigation interests; and third, an attempt by the city of Los Angeles to dam certain of the waters in the Yosemite. Any of these proposed uses would not only destroy specific areas of much beauty and scientific interest, but would serve as an entering wedge in opening the parks to all kinds of commercial uses which would eventually undermine the entire National Park system. It is important that scientists make their wishes in this matter known in no uncertain way.

Barrington Moore

New York, N. Y.

PROFESSOR PAVLOV

To the Editor of Science: Within the past few months Professor Pavlov came in for much comment on the pages of Science. Since most of the things that were brought to the attention of our scientific men were either based on mere hearsay or on second-hand information of the flimsiest sort, will you allow me the space to quote some direct news about Professor Pavlov.

H. G. Wells returned recently from a trip of inspection in Russia where he particularly investigated the condition of literary and scientific men. His extensive report has been just published by the *New York Times*. Speaking of the various scientists with whom he conferred, Wells says:

> Our blockade has cut them (the scientists) from all literature outside of Russia. They are without instruments. They are short of paper. The work they do has to go on in unheated laboratories. It is amazing that they do any work at all, yet they are getting work done.

Of Pavlov in particular he says:

> Pavlov is carrying on research of astonishing scope and ingenuity on the mentality of animals. . . . Pavlov continues his marvelous researches in an old coat and with his study piled up with the potatoes and carrots he grows in his spare time.

It is gratifying to be assured that Professor Pavlov is raising potatoes only as a pastime and still gives the best of his genius to scientific investigation.

S. Morgulis

A QUESTION OF BIBLIOGRAPHY

To the Editor of Science: Regarding the inquiry of Dr. Willey, Coues says on page 50, in "Fur-bearing Animals":

> From this country [Mackenzie River region], many accounts have reached me, from various officers of the Hudson's Bay Company, through the liberality of the Smithsonian Institution, which placed in my hands all the matter represented in its archives upon the mammals of the far north. . . . Messrs. Kennicott, Macfarlane, Ross and Lockhart have each recorded their experiences. . . .''

Therefore the following quotation from Dall's "Alaska and its Resources," p. 349, may be of interest.

> Woiwódsky was succeeded by Fúruhelm as Chief Director of the colonies. The Kadiák was wrecked near Spruce Island. Robert Kennicott passed the winter at Fort Yukon, where Mr. Lockhart was in command.

In the annual report of the Smithsonian Institution for 1861, p. 60, it is stated that "Mr. Ross, chief factor of the Mackenzie River district, has had the cooperation of the gentlemen resident at the different posts in his district," among those mentioned is Mr. James Lockhart. He is mentioned in subsequent reports of the Smithsonian Institution, but always as James; never as J. G.

In the "Biography of Baird," on p. 378,

Dall gives a letter from R. McFarland, in which the death of Lockhart is mentioned.

ROSE M. MACDONALD,
Librarian

U. S. BUREAU OF FISHERIES,
WASHINGTON, D. C.

RESEARCHES IN HELMINTHOLOGY AND PARASITOLOGY

TO THE EDITOR OF SCIENCE: The Smithsonian Institution published in 1904, the collected "Researches in *Helminthology* and Parasitology" (1844–1891) by Joseph Leidy, M.D., LL.D. The issue was gratis, and is now out of print.

The writer has been applied to by a number of research laboratories in comparative pathology for reprints—he would be glad to know of any one to whom complimentary copies were presented, who would be disposed to donate any such, for use among those engaged in similar lines of investigation.

JOSEPH LEIDY, JR.

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SPECIAL ARTICLES

A SIMPLE DEVICE FOR GIVING ANESTHETICS

So often in giving anesthetics to an animal through the trachea cannula the student either covers the intake opening with several layers of gauze, or plugs the opening with absorbent cotton. To these he applies the anesthetic. When these substances are moistened, the air passages which exist between the fibers in the dry condition are almost wholly obliterated, and the animal is more likely to become asphyxiated than anesthetized. To prevent this almost universal failing I have devised a simple trachea cannula, adapted to both normal and artificial respiration and an appliance for anesthetization, which slips over the intake opening of the cannula.

The cannula consists of a metal T-tube, Fig. 1, *C*. In the long part a small tube extending the full length is soldered. At one end, *I*, all of the opening into the larger portion of this double-barreled tube is closed with solder. thus leaving only the smaller tube open, *sm*. This end is attached to the artificial respiration apparatus, which practically closes it during normal respiration. The other end, *T*, is inserted into the trachea. The end views of these portions of the tube are shown at the left and right of the figure.

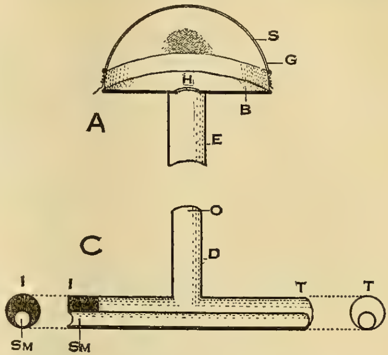

FIG. 1. *A*, anesthetic cone; *B*, circular base; *C*, cannula; *D* and *E*, intake and outlet tubes; *G*, gauze; *H*, hole into intake tube; *I*, end for attachment to artificial respiration apparatus; *O*, opening; *S*, wire screen; *sm*, small tube; *T*, trachea end of cannula.

The device for the administration of the anesthetic is made from a small hemispherical tea strainer (Fig. 1, *A*). The opening of the strainer is soldered to a circular metal plate (*B*) with a hole (*H*) in the center, and a metal tube (*E*) soldered on the lower surface. This tube is large enough to easily slip over the side tube (*D*) of the cannula. One or two layers of gauze (*G*) are spread over the wire screens (*S*) of the strainer and fastened by passing a string or rubber band around the lower margin. The gauze, which can be readily replaced, is thus held away from the intake opening and permits of free passage of air and the thorough vaporization and mixing of the anesthetic with good air. In this manner a few drops of the anesthetic at a time are sufficient to keep the animal in complete anesthesia.

In normal respiration the air passes freely in and out through the gauze and the tubes *E* and *D*. When artificial respiration is necessary all that is needed is to start the apparatus and the air going through the small tube (*sm*) enters the trachea with sufficient velocity to go well down into the lungs. With this device it is not necessary to closely approximate the volume of the normal tidal air, because any excess escapes at once through *O* without causing undue pressure in the lungs. An excess of air is therefore always desirable.

I have found that four different sizes of trachea cannulæ suffice for our needs. This, however, requires only a variation in size of the trachea end of the cannula. These different sizes can be made, therefore, so that the anesthetic cone will fit each of them.

This device commends itself because of its simplicity, its effectiveness, its cheapness, and the ease of manipulation.

J. R. Slonaker

Stanford University,
California

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION F—ZOOLOGY

The Convocation Week meetings of Section F (Zoology) of the American Association for the Advancement of Science were held in conjunction with those of the American Society of Zoologists at Chicago, Illinois, December 28, 29 and 30, 1920.

At the business meeting of the Section, Professor M. F. Guyer was elected member of the council. Professor H. W. Rand was elected secretary of Section F for five years. Professor C. C. Nutting was appointed member of the general committee, and Professor M. M. Metcalf, member of the section committee for five years.

The sectional committee nominated Professor C. A. Kofoid, of the University of California, as vice-president of the Section for the ensuing year.

The officers for the Toronto meeting will be:

Vice-president—C. A. Kofoid, University of California.

Retiring Vice-president—John Sterling Kingsley, University of Illinois.

Secretary—Herbert W. Rand, Harvard University.

Member of the Council—M. F. Guyer, University of Wisconsin.

Member of the General Committee—C. C. Nutting, University of Iowa.

Members of the Sectional Committee in addition to the officers above: Vice-president, St. Louis, W. M. Wheeler (1 year); V. E. Shelford (2 years); Herbert Osborn (3 years); H. B. Ward (4 years); M. M. Metcalf (5 years); H. V. Neal, Preceding Secretary; Ex-officio, W. C. Allee, secretary American Society of Zoologists.

The address of the retiring vice-president of Section F, Professor William Morton Wheeler, of Harvard University, upon "The organization of research," was delivered at the Biologists' smoker at the Ida Noyes Hall, Tuesday evening, December 28, at 8 o'clock. The address attracted an unusually large audience.

Under the rules of the association all arrangements for the program of the meetings were in the hands of the executive committee of the American Society of Zoologists. There were more than ninety papers on the program and it became necessary consequently to divide the program into two sections on Wednesday, the twenty-ninth, meeting simultaneously in the Harper Library and Room 14, Zoology Building.

The "popular interest" session of the meetings was a symposium on Fertilization, held in the Harper Library, at ten o'clock, on Thursday morning, December thirty. Papers were presented by C. A. Kofoid, F. R. Lillie, E. E. Just, O. C. Glaser, C. E. McClung (excused at personal request) and D. H. Tennant.

The attendance upon all of the meetings was so great as to tax the capacity of the rooms in which they were held.

H. V. Neal,
Secretary

Tufts College, Mass.

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ELECTRIFICATION OF WATER AND OSMOTIC FLOW[1]

I

The exchange of water and solutes between the cell and the surrounding fluid is one of the important factors in the mechanism of life, and a complete theory of the osmotic flow is therefore a postulate of biology. It was a marked advance when the experiments of Pfeffer and de Vries led van't Hoff to the formulation of the modern theory of osmotic pressure. According to this theory the molecules of the solute behave like the molecules of a gas in the same volume and at the same temperature, and the gas pressure of the solute measures the "attraction" of a watery solution for pure water through a strictly semipermeable membrane. Yet it is obvious to-day that in a liquid the electrical forces between solvent and solute must play a rôle and no adequate provision is made for these forces in van't Hoff's law. Traube rejected van't Hoff's theory altogether, suggesting instead that the osmotic flow was from the liquid with lower to the liquid with higher surface tension (and higher intrinsic pressure).

Tinker has shown that van't Hoff's theory for osmosis holds strictly only in the case of *ideal* solutions, *i.e.*, when the process of solution occurs without heat of dilution and change in volume, but that in the case of *non-ideal* solutions Traube's ideas explain the deviations from the gas law which are bound to occur. When two different *ideal* solutions containing equal numbers of particles of solute in equal volume are separated by a strictly semipermeable membrane, equal numbers of molecules of water will diffuse simul-

[1] Presidential address prepared for the Chicago meeting of the American Society of Naturalists, December 30, 1920.

taneously in opposite directions through the membrane and no change in volume will occur. When, however, the same experiment is made with two *non-ideal* solutions containing equal numbers of molecules in equal volume, the result is different. As Tinker has demonstrated mathematically, in this case the flow of water must be from the solution having the lower intrinsic pressure and lower surface tension to the solution with higher intrinsic pressure and higher surface tension. This is what Traube claims, and his theory explains therefore, as Tinker points out, the deviations from the gas law in the case of *non-ideal* solutions, but it does not prove that the gas law of osmotic flow does not hold in the case of *ideal* solutions and Traube's theory can not therefore replace van't Hoff's theory.

II

There is a second group of forces not taken into consideration in van't Hoff's law, namely the influence of the chemical nature of the membrane on the solvent. These forces become noticeable when the membrane separating the solution from the pure solvent is not strictly semipermeable. When water is in contact with a membrane it undergoes as a rule an electrification and this electrification of the particles of water plays a great rôle in the rate of the osmotic flow when the solution into which the water diffuses is an electrolyte.

The assumption that water diffusing through a membrane is as a rule, electrified, is justified by a large number of observations. Quincke demonstrated that when water is pressed through capillary tubes it is found to be electrically charged (the sign of charge being more frequently positive); while the tube has the opposite sign of charge, *e.g.*, negative, when the water is positively charged. When two solutions of weak electrolytes are separated by a membrane (which may be considered as a system of irregular capillary tubes) an electric current causes water to migrate to one of the two poles, according to the sign of its charge. By this method of so-called electrical endosmose it can be shown that water diffuses through collodion membranes in the form of positively charged particles. Collodion bags, cast in the shape of Erlenmeyer flasks, are filled with a weak and neutral solution of an electrolyte, *e.g.*, $M/256$ Na_2SO_4, and dipped into a beaker filled with the same solution of $M/256$ Na_2SO_4. The opening of the collodion bag is closed with a rubber stopper perforated by a glass tube serving as a manometer. When a platinum wire, forming the negative electrode of a constant current, is put through the glass tube into the collodion bag while the other pole of the battery dips into the outside solution, the liquid in the glass tube rises rapidly with the potential gradient between the two electrodes. The water therefore migrates through the collodion membrane in the form of positively charged particles. The writer has made a number of experiments[2] concerning the osmotic flow through collodion membranes, and it is the purpose of this address to give a brief survey of the results.

III

When a collodion bag is filled with a solution of a crystalloid, *e.g.*, sugar or salt, and dipped into a beaker containing pure water, the pure water will diffuse into the solution and the level of liquid in the capillary glass tube serving as a manometer will rise. At the same time particles of the solute will diffuse out of the bag (except when the solute is a protein solution or a solution of some other colloid). The concentration of a crystalloid solute inside the collodion bag will therefore become constantly smaller until finally the solution is identical on both sides of the membrane. Nevertheless the relative force with which a given solution inside the collodion bag "attracts" the pure water into which the bag is dipped can be measured by the initial rise in the level of water in the manometer, before the concentration of the solution has had time to diminish to any great extent through diffusion. Since in the

[2] Loeb, J., *J. Gen. Physiol.*, 1918–19, I., 717; 1919–20, II., 87, 173, 273, 387, 563, 659, 673.

first minutes accidental irregularities are liable to interfere with the result, we measure the rise in the level of liquid in the manometer during the first 20 minutes.

If the initial rise of level of liquid in the solution is thus measured it is noticed that it occurs approximately in proportion with the concentration of the solution when the solute is a non-electrolyte. The rate of diffusion of pure water into a solution of cane sugar through a collodion membrane is therefore approximately a linear function of the concentration of the solute within the limits of O and 1 *M*. This is what we should expect on the basis of van't Hoff's theory of osmotic pressure.

If, however, a watery solution of an electrolyte is separated from pure water by a collodion membrane, water diffuses into these solutions as if its particles were positively charged, and as if they were attracted by the anion of the electrolyte in solution and repelled by the cation with a force increasing with the valency of the ion (and another property of the ion to be discussed later).

Pure water diffuses into a *M*/128 solution of NaCl through a collodion membrane more rapidly than it diffuses into a *M*/64 solution of cane sugar; water diffuses into a *M*/192 solution of Na_2SO_4 or Na_2 oxalate still more rapidly than into a *M*/128 solution of NaCl; and into a *M*/256 solution of Na_3 citrate water diffuses more rapidly than into a *M*/192 solution of Na_2SO_4, and into a *M*/320 solution of $Na_4Fe(CN)_6$ still more rapidly than into a *M*/256 solution of Na_3 citrate. Assuming complete electrolytic dissociation of the electrolytes in these cases, the influence of the five solutions mentioned should be identical according to van't Hoff's theory. We notice, instead, that the "attraction" of the solutions for water increases with the valency of the anion. This is true for all neutral solutions of salts contained in a collodion bag, regardless of the nature of the cation.

If a collodion bag containing a neutral solution of a salt with bivalent cation, *e.g.*, *M*/192 $CaCl_2$ or $MgCl_2$, or with a trivalent cation, *eg.*, *M*/256 $LaCl_3$, is dipped into a beaker with pure water we notice no rise in the level of water in the manometer. In solutions with bivalent or trivalent cations the repulsion of the cation equals or exceeds therefore the attraction of the anion for the positively charged particles of water diffusing through the pores of the collodion membrane. Hence we conclude from these (and numerous similar) experiments that the particles of water diffuse through a collodion membrane as if they were positively charged and as if they were attracted by the anion of an electrolyte and repelled by the cation with a force increasing with the valency of the ion.

It seemed of interest to find that concentration of a cane sugar solution which just suffices to prevent the diffusion of water into a given solution of an electrolyte. Into each of a series of beakers, all containing the same neutral salt solution, *e.g.*, *M*/192 Na_2SO_4, was dipped a collodion bag containing a cane sugar solution of different concentration, from *M*/128 to 1 *M*, and it was observed in which of these sugar solutions the level in the manometer rose during the first 10 minutes, in which it fell, and in which it remained constant. It was found that the cane sugar solution which was just able to balance the

TABLE I

Approximate Concentration of a Solution of Cane Sugar Required to Balance the Osmotic Attraction of the Following Solutions of Electrolytes for Water

Molecular Concentration	Electrolyte Used	Approximate Molecular Concentration of Balancing Solution of Cane Sugar	
M/128	KCl		*M*/8
M/192	K_2SO_4	Between *M*/4 and	*M*/2
M/192	K_2 oxalate		*M*/2
M/192	K_2 tartrate	Slightly above	*M*/2
M/256	K_3 citrate	Slightly above	3*M*/4
M/128	RbCl		*M*/4
M/128	KCl		*M*/8
M/128	NaCl		*M*/8
M/128	LiCl	Slightly above	*M*/32
M/192	$MgCl_2$		*M*/64
M/192	$CaCl_2$	Below	*M*/64
M/192	$SrCl_2$	Below	*M*/64
M/192	$BaCl_2$		*M*/64
M/192	$CoCl_2$	Below	*M*/64
M/192	$MnCl_2$	Below	*M*/64

"attraction" of the $M/192$ solution of Na_2SO_4 for water had to have a concentration of about or over $M/4$. If the gas pressure effect alone determined the relative attraction of the two solutions for water the concentration of the sugar solutions required to osmotically balance the $M/192$ solution of Na_2SO_4 should have been $M/64$ (or slightly less). Hence the sugar solution balancing osmotically a $M/192$ Na_2SO_4 solution was found to be 16 times more concentrated than the theory of van't Hoff demands. This high concentration of cane sugar was needed to overcome the powerful "attractive" influence of the anions of a $M/192$ solution of Na_2SO_4 for the positively charged particles of water. Table I. shows the results of a few such experiments. The solution of the electrolyte was in these experiments always theoretically isosmotic with a $M/64$ cane sugar solution (on the assumption of complete electrolytic dissociation). The data contained in Table I. have only a qualitative value since no attempt at an exact determination of the concentration of the balancing sugar solutions was made. The data show, however, that the "attraction" of $M/128$ KCl for positively charged particles of water is eight times as great, that of K_2SO_4 sixteen times as great, and that of $M/256$ K_3 citrate almost forty-eight times as great as that of $M/64$ cane sugar; while the "attraction" of a $M/192$ solution of a salt with a bivalent cation and monovalent anion, like $MgCl_2$, for water is not greater than that of a $M/64$ solution of cane sugar.

These experiments then prove that the rate of diffusion of water from the side of pure water through a collodion membrane into a solution of an electrolyte increases with the valency of the anion and diminishes with the valency of the cation. They give also a rough idea of the relative influence of these ions upon the rate of diffusion of positively charged water through the pores of the collodion membrane from the side of pure water to the side of the solution.

A second fact brought out in these experiments was that the relative influence of the oppositely charged ions of an electrolyte in solution upon the rate of diffusion of positively charged water from the side of pure water to the side of the solution is not the same in all concentrations. Beginning with the lowest concentrations the "attractive" effect of the anion for positively charged water increases more rapidly with increasing concentration than the "repulsive" effect of the cation until the concentration of the electrolyte is about $M/256$; from then on the "repulsion" of the cation upon positively charged water increases more rapidly than the "attractive" effect of the anion. As a consequence we can say that in concentrations of neutral salts between $M/256$ and $M/8$ the "attraction" of the solution for water diminishes with increasing concentration. This is the reverse of what we should expect if the gas law alone determined the attraction of water by solutions of electrolytes. When the concentration of the solution is $M/8$, the apparent electrostatic effects of the ions upon the positively charged particles of water disappear and for concentrations above $M/8$ the curves for the attraction of water by electrolytes and by sugar solutions show less difference.

We have already mentioned the fact that the valency of the ion is not the only quantity which determines its influence on the rate of diffusion of water through a collodion membrane. In addition to the valency (or the number of electrical charges) a second quantity of the ion enters which may be designated provisionally as the influence of the radius of the ion. In the case of monovalent and monatomic cations the retarding influence on the rate of diffusion of positively charged particles of water through the collodion membrane from the side of pure water into a solution increases inversely with the radius of the ion, namely in the order Li > Na > K > Rb, where the retarding effect is greatest in the case of Li and least in the case of Rb; while in the case of monatomic monovalent anions the accelerating effect upon the rate of diffusion of positively charged particles of water from the side of pure water through the membrane into the

solution increases directly with the radius of the ion I > Br > Cl; where I has the greatest and Cl the smallest attractive action.

This might be intelligible if the action of the ions on the particles of water were electrostatic, since in this case the action of the anion depends on the negative charge in its outermost shell of electrons and the electrostatic effect should be the greater the farther the shell is removed from the positive nucleus of the ion; while the electrostatic effect of the cation is due to the positive charge of the nucleus and this should be the greater the smaller the distance between nucleus and the outermost layer of electrons, *i.e.*, the closer the positive nucleus can approach the water particles or the membrane particles on which the ion is to act.

IV

We have alluded to the fact that collodion membranes are not strictly semipermeable and that crystalline solutes diffuse out from the collodion flasks in our experiments. It might be argued that the differences in the flow of water measured in the preceding chapter are due to differences in the rate of diffusion of electrolytes from the side of the solution to the side of pure water through the collodion membrane. This assumption is, however, not tenable since it can be shown that the diffusion of the solutes into the pure water through the collodion membrane seems to follow Fick's diffusion law according to which the rate of diffusion of a solute is directly proportional to its concentration and this seems to hold equally in the case of electrolytes and non-electrolytes. The specific influence of solutions of *electrolytes* on the rate of diffusion of water from pure water through collodion membranes into solutions can therefore not be due to any difference in the rate of diffusion of electrolytes and non-electrolytes through the membrane into the pure water, but must be ascribed to a difference in the behavior of water towards these two types of solutes.

V

We have thus far mentioned only the influence of electrolytes on the rate of diffusion of positively charged particles of water. Perrin found in his experiments on electrical endosmose that in certain cases the water migrated to the positive electrode, namely when the solution had an acid reaction, while it migrated to the negative electrode when the solution had an alkaline reaction. No such reversal in the sign of electrification of water can be produced in the case of pure collodion membranes, since in this case the water is always positively charged no matter whether the solution is acid, neutral, or alkaline. When, however, we deposit a film of a protein on the inside (or on both sides) of the collodion membrane the latter becomes amphoteric. When the solution is sufficiently acid, the water migrates through the membrane as if its particles were negatively charged, while when the hydrogen ion concentration is lower, *i.e.*, when the solution is only very faintly acid or neutral or alkaline, the water particles move through the protein film of the membrane as if they were positively charged.

When we separate an acid solution of a salt by a collodion membrane possessing a protein film, from a solution of a pure acid of the same hydrogen ion concentration as that of the salt solution, the hydrogen ion concentration being equal to or above 10^{-4} N, the water migrates through the pores of the membrane as if its particles were negatively charged and as if they were "attracted" by the cation and "repelled" by the anion of the electrolyte in solution with a force increasing with the valency of the ion. In this case, water is "attracted" more powerfully by salts with trivalent cation, *e.g.*, $AlCl_3$ or $LaCl_3$, than by salts with bivalent cation *e.g.*, $MgCl_2$ or $CaCl_2$; and it is "attracted" more powerfully by the latter than by salts with monovalent cation, *e.g.*, NaCl or KCl; while negatively charged water is not "attracted" by salts with bivalent or trivalent anions, *e.g.*, Na_2SO_4 or Na^4 oxalate or $Na_4Fe(CN)_6$, etc.

In the case of salts with monatomic and monovalent cations the "attraction of" the salt for negatively charged water seems to increase inversely with the radius of the

cation in the order Li > Na > K > Rb, where Li with the smallest radius "attracts" the negatively charged water most and Rb with the largest radius "attracts" the water least. The monatomic monovalent anions "repel" the negatively charged particles of water directly in proportion with the radius of the ion in the order I > Br > Cl, where I with the greatest radius "repels" the negatively charged water most, and Cl least.

The relative "attractive" and "repelling" action of the two oppositely charged ions of an electrolyte for negatively charged water is not the same in all concentrations. In the lowest concentrations the attractive influence of the cation for negatively charged water increases more rapidly with increasing concentration than does the repelling action of the anion; while beyond a certain concentration the repelling action of the anion on the negatively charged water increases more rapidly than the attractive action of the cation. Finally a concentration is reached where the electrical effects of the two oppositely charged ions balance each other more or less and from then on the solution behaves more like that of a non-electrolyte.

VI

In the course of these experiments facts were observed which indicate a chemical source for the electrification of water when in contact with a collodion membrane. We have mentioned the fact that when a membrane has been treated with a protein, the sign of the electrification of water in contact with the membrane can be reversed by acid. The protein forms a fine film on the surface and probably inside the pores of the collodion membrane. In an alkaline or neutral, and often even a very faintly acid concentration the water in contact with the protein film is positively charged, but when the hydrogen ion concentration exceeds a certain limit the water assumes a negative charge. The writer has measured the hydrogen ion concentration at which this reversal occurs and has found that it changes in a characteristic way with a certain chemical constant of the protein which constitutes the film, namely its isoelectric point. Proteins are amphoteric electrolytes which behave differently on the two sides of a hydrogen ion concentration which is termed the isoelectric point. On the alkaline side from the isoelectric point proteins behave like a fatty acid, *e.g.*, CH_3COOH, forming metal proteinates with alkalies, *e.g.*, Na proteinate. On the acid side of the isoelectric point the proteins behave like NH_3, forming protein-acid salts, *e.g.*, protein chloride. We may imagine that proteins exist in the form of two isomers, one on the alkaline side of the isoelectric point possessing COOH as the active chemical group; the other on the acid side of the isoelectric point possessing NH_2 as the chemically active group. The isoelectric point, *i.e.*, the hydrogen ion concentration at which the reversal of one type of protein salt to the other occurs, is a characteristic constitutional property of each protein. Its value is, according to L. Michaelis, a hydrogen ion concentration of $10^{-4.7}N$ for gelatin and for casein, $10^{-4.8}N$ for crystalline egg albumin, and $10^{-6.8}N$ for oxyhemoglobin.

The writer has been able to show that the reversal of the sign of charge of water when in contact with a collodion membrane possessing a protein film practically coincides with the isoelectric point of the protein used, lying slightly on the acid side of this point. The method of determining the hydrogen ion concentration at which the reversal in the sign of electrification of water occurs is as follows: We have shown that $M/64$ $CaCl_2$ or $M/256$ $LaCl_3$ "attract" negatively charged water powerfully, while these two salts do not "attract" positively charged water. On the other hand, Na_2SO_4 "attracts" positively charged water powerfully while it does not "attract" negatively charged water. We fill a series of collodion bags previously treated with a protein each with a $M/64$ $CaCl_2$ solution, and dip each collodion bag into a beaker with distilled water. The $M/64$ $CaCl_2$ solution in each bag is brought to a different hydrogen ion concentration by adding suitable quantities of HNO_3 or NaOH to the

solution; and the distilled water in the beaker is always brought to the same hydrogen ion concentration as that of the $M/64$ $CaCl_2$ solution inside the collodion bag dipped into the beaker. Similar experiments are made with Na_2SO_4 brought to a different hydrogen ion concentration. The result of these experiments is striking. There is always one definite hydrogen ion concentration at which the "attraction" of both $M/64$ $CaCl_2$ (or $LaCl_2$) as well as that of $M/256$ Na_2SO_4 for water is almost zero. As soon as the hydrogen ion concentration rises, the attraction of $M/64$ $CaCl_2$ for water becomes noticeable and increases with a further increase in the hydrogen ion concentration until it reaches a maximum (at a hydrogen ion concentration of about $10^{-3}N$). The attraction of M/256 Na_2SO_4 for water rises when the hydrogen ion concentration falls below the point where the attraction is zero. $M/256$ Na_2SO_4 attracts water when it is positively charged and $M/64$ $CaCl_2$ does so when water is negatively charged. Where neither solution "attracts" water the latter is not electrified. (It should be mentioned that the attraction of a cane sugar solution of $M/64$ or below for water is very slight and scarcely noticeable, and that this is the reason that when water is not electrified it is not noticeably attracted by $M/64$ $CaCl_2$ or $M/256$ Na_2SO_4.) Table II. shows the close relation of this hydrogen ion concentration and that of the isoelectric point for different proteins. Water begins to become negatively charged in contact with a collodion membrane as soon as the hydrogen ion concentration is slightly on the acid side of the isoelectric point of the protein forming a film on the membrane.

TABLE II

Nature of Protein Film on the Membrane	Hydrogen Ion Concentration where Water is Uncharged	Isoelectric Point of Protein
Gelatin	Between $10^{-4.0}$ and $10^{-4.6}N$	$10^{-4.7}N$
Casein	" " " "	$10^{-4.7}N$
Egg albumin	" " " "	$10^{-4.8}N$
Oxyhemoglobin	About $10^{-6.0}$ and $10^{-7.0}N$	$10^{-6.8}N$

The quantitative agreement between the isoelectric point of the protein forming the film on a collodion membrane and the point of reversal of the sign of electrification of water is such that it is difficult to question the connection between the chemical constitution of the protein and the sign of electrification of water. It is also obvious that the density of the charge varies with the hydrogen ion concentration.

When the collodion membrane is not treated with a protein the water is always positively charged and no reversal in the sign of the charge can be obtained by an increase in the hydrogen ion concentration. This harmonizes with the fact that collodion is not an amphoteric electrolyte.

It is to be expected that in addition to the chemical nature of the membrane the chemical nature of the liquid in contact with the water also influences the sign (and density) of the electrical charge at the boundary of the two phases. Indications supporting this view exist but they can not be discussed in this connection.

VII

van't Hoff's theory of osmotic pressure confronted the physiologists with the puzzling fact that in the phenomena of secretion water diffused often from places of higher to those of lower osmotic pressure. In 1908 Girard suggested that such cases of abnormal osmosis as occur in organisms might be explained on the assumption that the opposite sides of a membrane separating pure water from an acid or alkaline solution are oppositely charged, and that therefore Perrin's experiments on electrical endosmose furnish the explanation of these phenomena. According to Girard, only H or OH ions should produce such a difference in charge and neutral solutions of electrolytes should behave like solutions of non-electrolytes which is, however, not correct. Bernstein, in 1910, also reached the conclusion that electrical endosmose might be utilized for the explanation of abnormal osmosis as manifested in secretion and in his book on "Electro-Biology" many speculations in this direction are offered but unfortunately very few experiments. He also assumes that the opposite sides of the mem-

brane of a gland are oppositely charged. Under such circumstances positively charged water particles will be driven in the direction from the positive to the negative side of the membrane. As soon as the positively charged water particle reaches the negative side of the membrane it gives off its charge. This enables other positively charged water particles to follow.

Ideas similar to those offered by Girard and by Bernstein have been expressed by way of explanation of other cases of abnormal osmosis by Bartell and his collaborators, and by Freundlich.

Whatever the ultimate theory of the driving force in these cases may be, we have a right to state that the electrification of the particles of water migrating through a membrane is a fact; that the sign of this electrification seems to depend on the chemical nature of the membrane in contact with water; that the rate of migration of these charged particles of water through the membrane from the side of pure water to the side of the solution is accelerated by the ions of the opposite sign of charge and retarded by the ions with the same sign of charge as that of the water with a force increasing with the valency of the ion; and that the relative acceleration and retarding effects of the two oppositely charged ions on the rate of diffusion of electrified water are not the same for all concentrations, that in lower concentrations of electrolytes the accelerating action of the oppositely charged ion increases at first more rapidly than the retarding effect of the other ion; while for higher concentrations the reverse is the case, until finally a concentration of the electrolyte is reached where the effects of the oppositely charged ions more nearly balance each other.

Jacques Loeb

The Rockefeller Institute
for Medical Research,
New York, N. Y.

HENRY ANDREWS BUMSTEAD

My personal acquaintance with Henry A. Bumstead dates from a meeting of the British Association in Winnipeg in the summer of 1909. He had studied in Cambridge, England, where his engaging personality, keen intelligence, and unusual *savoir faire* had made him a place in the hearts and homes of English scientists which has been held by few Americans. I was then almost unknown both to him and to them, but I soon learned that if Bumstead was in any gathering I should at once feel at home.

I was walking with him one day through one of the busy streets of Winnipeg when he asked if I would not step into a shop with him while he bought a little memento for Mrs. Bumstead, a "bad habit" which he said he had formed on trips away from home.

I mention these two trivial incidents because they reveal the soul and heart of the man; and what, after all, is either science or art in comparison?

When in 1917 the important and difficult post of scientific attaché in London was created, Bumstead was the only man considered, for no scientist in this country had his tact, his judgment, his knowledge of England, and his ability to assist in bringing about what was then, and what is now, the most important need of the modern world, namely, the cooperation and mutual understanding of the two great branches of the Anglo-Saxon race.

Bumstead's success in London was extraordinary. The British liked and trusted him. Admiral Sims and our own War Department placed large responsibilities upon him, and his office became the center of a very active and very important service. Young American officers who went abroad on scientific missions found him the center of their contacts and the prime source of their usefulness. They all became his devoted admirers. Not one or two but a dozen or more of both British and American officers who came to Washington during the war told me that they owed their success in their work in England and the continent primarily to Bumstead, and counted it the most valuable part of their experience that they had had an opportunity to become acquainted with him. One of these officers de-

scribed him as the most influential American in England.

As chairman of the National Research Council, as member of the National Research Fellowship Board, and as participant in other important groups with which he was associated at the time of his death, Bumstead showed the same broad outlook, the same big human interest, the same tact, the same sane intelligence and sound judgment which had characterized his work in England.

He spent practically the whole of the holiday week at my home in attendance upon the meetings of the Physical Society and of various committees of which he was a member. He was apparently in the best of health and spirits. Indeed, he spent Friday morning, December 31, going over with me the research work of the Ryerson Laboratory, and as we chatted together before he left about future plans he remarked that since his last operation some four years ago he had been feeling in excellent condition. He left me at about 11:30, intending to take the afternoon train for Washington. The next morning Dr. Vernon Kellogg, who occupied the berth opposite him, attempted to awaken him and found that he had gone.

He leaves a big gap in the ranks of American physicists. Born just fifty-one years ago in Pekin, Illinois, and educated in the public schools of Decatur, from which he went first to Johns Hopkins and then to Yale, he had done honor to the state which gave to this country Lincoln and Grant. He had been president of the American Physical Society, director of the Sloane Physical Laboratory since 1906, a very influential member of the Yale faculty, a member of the National Academy of Sciences, and a fellow of the American Academy of Arts and Sciences. He had a brilliant analytical mind, profound scholarship, exceptional critical capacity, excellent judgment, an extraordinary winsome personality, the finest culture, and a great heart. His personal scientific contributions were important, though they had been much interferred with by his none too rugged health. His effect upon American physics, however, was not limited to his own scientific papers, but he exerted a powerful influence upon his pupils and upon his fellow physicists.

It is not merely American science, however, which can ill afford to lose him twenty years before his time. American life in all its aspects is sadly in need of men of Bumstead's type. The cause of sanity, of culture, of Anglo-Saxon solidarity, of scholarship, of science, of world civilization, all suffer irreparably through his death.

R. A. MILLIKAN

SCIENTIFIC EVENTS

POLAR RESEARCH

The Christian Science Monitor reports that the Ambassador of the United States in London, Mr. John W. Davis, visited the meeting of the Royal Geographical Society held at the close of the year to discharge a pleasant duty with which he had been intrusted by the American Geographical Society of New York. When the centenary of the birth of David Livingston was celebrated in 1913, the Hispanic Society of America founded a gold medal for exploration and placed it at the disposal of the American Geographical Society. It is one of the highest awards in the geographical world, and its latest recipient is Dr. W. S. Bruce, who has devoted his life to the extension of knowledge of the Arctic and Antarctic regions. This medal was presented by Mr. Davis. In the unavoidable absence of Dr. Bruce the medal was received on his behalf by Dr. R. N. Rudmose Brown, who has served under Dr. Bruce in both the north and the south polar regions. The ceremony emphasized the close interest which the American and English peoples have taken in popular research. Mr. Davis, in making the presentation, expressed his satisfaction that the American Geographical Society had not imposed any narrow confines on their choice of a recipient; and Dr. Rudmose Brown, in returning thanks, said that Dr. Bruce's gratification at receiving the medal would be increased by the thought that it had been adjudged to him by the countrymen of such explorers as Wilkes and Greely.

The meeting at which the presentation was made was devoted to a lecture on the future of polar exploration by Frank Debenham, who served as a geologist on Captain Scott's last expedition. Several other polar explorers were present, among them Sir Ernest Shackelton and Dr. G. C. Simpson, the present director of the Meteorological Office. Mr. Debenham's lecture was a reply to the question which is so often asked: What is the good of polar exploration? He justified it on commercial, national, scientific and ethical grounds. On the first ground he claimed that the industries which had been developed as a result of Arctic and Antarctic exploration had yielded far larger returns than the cost of all the polar expeditions that ever sailed. There are world-wide problems requiring solution which can not be studied adequately without the aid of observations in the polar regions.

Mr. Debenham announced that the trustees of the Captain Scott memorial fund had decided to establish a polar research institute. It will be attached to the School of Geography at Cambridge University, anl will comprise a library, a museum, and a small set of research rooms.

ANTHROPOLOGICAL PUBLICATIONS OF THE CANADIAN ARCTIC EXPEDITION

The Arctic Board, which is a body composed of a number of scientists in the employ of the Canadian government, has been arranging for the publications of a series of scientific monographs based on the results of the Canadian Arctic Expedition, 1913–1918. The complete report is planned to take up sixteen volumes, many of which are subdivided into parts. A considerable number of the papers dealing with zoology and botany have already been issued.

The last 5 volumes of the series are to be devoted to anthropology. The complete anthropological schedule so far as it can be definitely planned at the present date is as follows:

VOLUME XII: LIFE OF THE COPPER ESKIMOS

The Life of the Copper Eskimos. By D. Jenness. (*In press*).

VOLUME XIII: PHYSICAL CHARACTERISTICS AND TECHNOLOGY OF THE COPPER ESKIMOS

Part A: The Physical Characteristics of the Copper Eskimos. By D. Jenness (in part). (*In preparation.*)

Part B: Technology of the Copper Eskimos. (*To be prepared.*)

VOLUME XIV: ESKIMO FOLK-LORE AND LANGUAGE

Part A: Folk-Lore, with Texts from Alaska, the Mackenzie Delta, and Coronation Gulf. By D. Jenness. (*In preparation.*)

Part B: Comparative Grammar and Vocabulary of the Eskimo Dialects of Point Barrow, the Mackenzie Delta, and Coronation Gulf. By D. Jenness. (*In preparation.*)

VOLUME XV: ESKIMO STRING FIGURES AND SONGS

Part A: String Figures of the Eskimo. By D. Jenness. (*Ready for press.*)

Part B: Songs of the Copper Eskimos. By D. Jenness (in part). (*In preparation.*)

VOLUME XVI: ARCHEOLOGY

Contributions to the Archeology of Western Arctic America. (*To be prepared.*)

ADMINISTRATION OF THE ALASKA FORESTS

Secretary Meredith, of the Department of Agriculture, approved the establishment on January 1 of a new National Forest District, for Alaska. This will be known as the Alaska District, with headquarters at Juneau, and will be in charge of Charles H. Flory, as district forester. Mr. Flory has been superintendent of Alaska National Forests for the past two years, with headquarters at Ketchikan. The new district headquarters will remain at Ketchikan until July 1.

Colonel W. B. Greeley, the chief forester of the Forest Service, spent some time in Alaska last summer, securing information on conditions there, and as the result of his trip recommended to Secretary Meredith the establishment of a separate National Forest District. There are two National Forests in Alaska, the Tongass in southeast Alaska and the Chugach in the Prince William Sound country. These forests are now included in the North Pacific District and are under direction of District Forester George H. Cecil, in Portland.

The Alaska National Forests now become a separate district because of their increasing importance as a source of pulp material and

mainly in order to get local administration, which the Forest Service has followed since 1908, when district headquarters were established in six western cities for the protection and administration of the national forests.

The announcement of the establishment of the new district is made at the Portland office almost simultaneously with the news from Washington that the President has authorized an Inter-Departmental Committee to coordinate federal activities in Washington having to do with Alaska. E. A. Sherman, associate forester of the Forest Service, who spent some time in Alaska, represents the Department of Agriculture on the new Alaska committee.

FISHERY MATTERS IN CONGRESS

Appropriations for the Bureau of Fisheries for the fiscal year 1922, as carried in the sundry civil appropriation bill reported to the House of Representatives on December 29, aggregate $1,240,460, an increase of $29,150 over the appropriations for the current year. The increase is made up chiefly of additions of $12,500 for the division of fishery industries and $15,000 for the Alaska service. No new position is created except that of engineer at the Cape Vincent station, no special appropriations are made, and no increases in salaries are provided except in the case of naturalist of the steamer *Albatross.*

Congressman Esch, of Wisconsin, has introduced a bill (H. R. 14676) providing for the establishment of a fish-rescue and fish-cultural station on the Mississippi River in Wisconsin. The bill carries an appropriation of $75,000 and creates a staff of 15 persons, with annual salaries aggregating $22,800.

Senator McNary, of Oregon, has introduced a joint resolution (S. J. Res. 211) requesting the President to negotiate a treaty or treaties to protect from unnecessary destruction, through wasteful practises, devices, and methods, the salmon in waters of the Pacific Ocean off the coasts of the United States and Canada, both within and beyond the territorial limits of the two countries.

THE WASHINGTON ACADEMY OF SCIENCES

At the annual meeting of the Washington Academy of Sciences on January 11, officers were elected for the year 1921. The board of managers for the year is as follows:

Dr. A. H. Brooks, Geological Survey, President, Member Executive Committee.

Dr. Robert B. Sosman, Geophysical Laboratory, Corresponding Secretary, Member Executive Committee.

Mr. Wm. R. Maxon, National Museum, Recording Secretary, Member Executive Committee.

Mr. R. L. Faris, Coast and Geodetic Survey, Treasurer, Member Executive Committee, Vice-president from Society of Engineers.

Dr. J. McKeen Cattell, Garrison-on-Hudson, N. Y., Non-resident Vice-president.

Professor E. B. Wilson, Mass. Inst. Tech., Cambridge, Mass., Non-resident Vice-president.

Dr. C. G. Abbot, Smithsonian Institution, Member of Board of Managers (1922).

Dr. W. F. Hillebrand, Bureau of Standards, Member of Board of Managers (1922).

Dr. L. A. Bauer, Department of Terrestrial Magnetism, Member of Board of Managers (1923).

Dr. T. Wayland Vaughan, Geological Survey, Mem- of Board of Managers (1923).

Professor H. S. Graves, 3454 Newark Street, Member of Board of Managers (1924).

Mr. Sidney Paige, Geological Survey, Member of Board of Managers (1924).

Dr. W. J. Humphreys, Weather Bureau, Vice-president from Philosophical Society.

Dr. Aleš Hrdlička, National Museum, Vice-president from Archeological Society.

Mr. N. Hollister, Zoological Park, Vice-president from Biological Society.

Dr. A. S. Hitchcock, Smithsonian Institution, Vice-president from Botanical Society.

Dr. William Blum, Bureau of Standards, Vice-president from Chemical Society.

Dr. F. B. Silsbee, Bureau of Standards, Vice-president from Electrical Engineers, Member of Executive Committee.

Mr. S. A. Rohwer, East Falls Church, Va., Vice-president from Entomological Society.

Mr. Raphael Zon, Forest Service, Vice-president from Foresters Society.

Mr. F. V. Coville, Bureau of Plant Industry, Vice-president from Geographic Society, Member of Executive Committee.

Dr. David White, Geological Survey, Vice-president from Geological Society.

Mr. Allen C. Clark, 816 14th St., Vice-president from Historical Society.

SAMUEL J. MELTZER[1]

The scientific staff of the Rockefeller Institute for Medical Research has learned with profound grief of the death of Dr. Samuel J. Meltzer. At a special meeting of the staff, held on November 12, 1920, it was resolved: That an expression be recorded of the sense of great loss which his passing away has occasioned.

Dr. Meltzer has been associated with the institute from the time of its inception. His great learning, his devotion to medical science, and his love for his fellow men continuously prompted the expenditure of his utmost effort in the causes to which the labor of the institute is dedicated. In this service he spent wholeheartedly the last sixteen years of his life, and in this service, in the fulness of his powers, he has died. He did not know how to spare himself in the devotion of his life to this great purpose.

The staff of the institute is conscious, however, not only of his service to the idea of the institute, but delights to recall the direction and purpose his inspiration gave to the development of medicine and medical research in the United States. His leadership and his contributions are second to the contributions of no other man in their significance for this generation of medical men. Dr. Meltzer's interest in humanity transcended the field of his medical activities. In the spirit of human cooperation he desired to include all men, so that there might flow, across the boundaries of nations, a desire for progress in the direction of universal ideals. These great interests were recognized, not only in this country, but in Europe as well, and gave Dr. Meltzer a unique position as a lover of his kind.

These are the thoughts which the staff desires to record. They indicate how widely the influence of Dr. Meltzer was spread, how intensely his example was appreciated here.

The staff desires to convey its profound sympathy to the family of Dr. Melzer, and in this resolution to acquaint them with a measure of the regard in which he was held. For the staff, Dr. Meltzer has not died; by the spirit of his example, he has helped to make the spirit of the institute, and this spirit will continue while the institute endures.

[1] Resolutions passed by the Scientific Staff of the Rockefeller Institute for Medical Research.

SCIENTIFIC NOTES AND NEWS

Dr. J. Norris Russell, of Princeton University, has been awarded the gold medal of the Royal Astronomical Society. Professor Russell will sail for London on January 29 to be present when the presentation is made.

Professor J. F. Kemp, of Columbia University, was elected president of the Geological Society of America, at the recent Chicago meeting.

Professor Gilbert Ames Bliss, of the department of mathematics at the University of Chicago, has been elected president of the American Mathematical Society.

Dr. James P. Southall, professor of physics in Columbia University, has been elected president of the American Optical Society.

A luncheon has been given in the Smithsonian Building in honor of the seventieth birthday of Dr. J. W. Fewkes, chief of the Bureau of American Ethnology.

Dr. Edwin Herbert Hall, Rumford professor of physics in Harvard University, will, on September 1, become professor emeritus.

At the recent Chicago meeting, the council of the American Association for the Advancement of Science directed the permanent secretary to appoint an assistant secretary, the duties of this officer being to aid the permanent secretary in the editorial and scientific aspects of the work of the association. Dr. Sam F. Trelease has been appointed assistant secretary. Dr. Trelease has recently returned to America after several years of service in the school of agriculture of the University of the Philippines at Los Baños. The assistant secretary will devote part of his time to the work of the association, being also on the staff of the laboratory of plant physiology of the Johns Hopkins University.

Samuel Wagner, president of the Board of trustees of the Wagner Free Institute of Science since the death of the founder in 1885 resigned on January 18 and was elected president emeritus. Samuel Tobias Wagner, chief engineer of the Philadelphia and Reading Railway, was elected president of the board.

Charles E. Thorne, who has been director of the Ohio Agricultural Experiment Station since June, 1887, has been released from the directorship at his own request, but remains in charge of the station's investigations in soil fertility. Mr. C. G. Williams, agronomist of the station since 1902 and associate director since 1917, has been appointed acting director.

Mr. Lloyd R. Watson, assistant in apiculture, U. S. Bureau of Entomology, has accepted the position of apiculturist with the Division of Entomology of the Texas State Agricultural Experiment Station, made vacant recently by the resignation of Mr. H. B. Parks. Mr. Parks has accepted a position with the Texas State Honey Producers Association and is secretary of the National Honey Producers League.

The government of Czecho-Slovakia has secured the services of Dr. Selskar M. Gunn, formerly of the Massachusetts Institute of Technology, as technical adviser to the ministry of public health and physical education. This appointment is in accordance with an official request from the ministry to the Rockefeller Foundation, with which Dr. Gunn has for the last three years served as associate director of the International Health Board, to supply them with such an adviser. Dr. Gunn has sailed for Europe en route to Prague and will remain indefinitely, although he has not severed his connection with the foundation.

Dr. Oscar Klotz, professor of pathology in the University of Pittsburgh Medical School, has been appointed a representative of the International Health Board of the Rockefeller Foundation for work in medical research and education in São Paulo, Brazil. It is expected that Dr. Klotz will spend a number of years in Brazil, during which time he will serve as director of a pathologic institute. He will be assisted by several Brazilian physicians who have received training in the United States.

Dr. Donald B. MacMillan plans to leave the United States next spring for a two- year scientific expedition to the Arctic region.

Sir Arthur Newsholme, M.D., resident lecturer in charge of Public Health Administration, School of Hygiene and Public Health, Johns Hopkins University, will deliver the sixth Harvey Society Lecture at the New York Academy of Medicine on January 29. His subject will be "National changes in health longevity."

Dr. Vernon Lyman Kellogg, permanent secretary of the National Research Council, recently gave, under the Charles K. Colver Fund at Brown University, three lectures on "Human life as a biologist sees it." These lectures were delivered on January tenth, seventeenth and twenty-fourth.

Dr. Kenneth E. Mees, director of the research laboratory of the Eastman Kodak Company, gave, last week, an illustrated lecture on "Color photography," at Cornell University.

Professor Douglas W. Johnson, of Columbia University, who was chief of the Division of Boundary Geography on the American Commission to Negotiate Peace, addressed the *Public Ledger* forum on the Peace Conference at the Academy of Music in Philadelphia, January 7, on the subject of "Fiume and the Adriatic problem." Professor Johnson is also delivering a series of four illustrated lectures on "The rôle of geography in world affairs," before the Columbia Institute of Arts and Sciences in New York City.

Professor Edgar James Swift, head of the department of psychology and education in Washington University, has been invited by the administrative officers of the post graduate school of the United States Naval Academy at Annapolis to repeat the lectures which he gave before the officers and students last spring. Professor Swift will lecture on "Thinking and acting," on February 19, and on "The psychology of managing men," on April 9.

A ceremony was held at the Massachusetts Institute of Technology on the first anniversary of the death of Richard Cockburn Mac-

laurin, formerly president. Reginald H. Smithwick, of Boston, president of the senior class and chairman of the Institute Committee, placed a wreath on the memorial which has been erected in memory of Dr. Maclaurin in the lobby of the Walker Memorial building.

We learn from the *Journal* of the Washington Academy of Sciences that Mr. Ralph W. Howell, geologist with the U. S. Geological Survey, was killed by native raiders in Beluchistan in the latter part of November, 1920. He was engaged at the time in oil exploratory work for Pearson & Son, of London, and was working near the Beluchistan-Punjab border in an area that had been considered safe from bandits. Mr. Howell was born in 1886, and had been a member of the Survey staff since 1913. He was granted leave of absence from the survey in October, 1919, to engage in private work.

On December 21, at a conference between representatives of the Department of Commerce and the Department of Agriculture held in the office of the secretary of commerce, the Bureau of Chemistry of the Department of Agriculture made known its willingness to withdraw from future investigations of fishery products, and at the same time agreed to ask Congress to transfer to the Bureau of Fisheries the item for fish investigations included in the pending estimates for the Department of Agriculture for the fiscal year beginning July 1, 1921.

UNIVERSITY AND EDUCATIONAL NEWS

The faculty of Mount Holyoke College has voted to raise a fund of $100,000 to endow the president's chair in recognition of Miss Mary E. Woolley's twenty years' service as president of Mount Holyoke.

The first Congress of the Universities of the British Empire was held in London in 1912 when all, to the number of fifty-three, were represented. It was decided to hold the congresses every five years, but the war made it impossible to do so in 1917. The second congress will accordingly be held in the summer of 1921. The number of British universities has in the meantime increased to fifty-eight.

Professor Eugene Taylor, of the University of Wisconsin, has been appointed head of the department of mathematics at the University of Idaho.

Doak B. Carrick has been elected professor of pomology, and Arno H. Nehrling assistant professor of floriculture in the college of agriculture, Cornell University.

Professor Edwin T. Hodge, head of the department of mining geology in the University of British Columbia, has joined the department of geology of the University of Oregon.

The *Bulletin* of the American Mathematical Society states that in the faculty of sciences of the University of Paris, the following changes have been made: Dr. Emile Borel, professor of the theory of functions, has been appointed professor of the calculus of probabilities and mathematical physics, as successor to Professor B. J. Boussinesq, who has retired; Dr. Paul Painlevé, professor of rational mechanics, has been appointed professor of analytical and celestial mechanics, as successor to Professor Paul Appell; Professor Elie Cartan succeeds Professor Painlevé in the chair of rational mechanics, and Professor Ernest Vessiot, recently appointed assistant director of the Ecole normale supérieure, succeeds Professor Cartan in the chair of the differential calculus; Dr. J. Drach has been appointed professor of general mathematics, and Dr. Paul Montel maître de conférences in mathematics.

DISCUSSION AND CORRESPONDENCE

A METEOR FALL IN THE ATLANTIC

It may be of interest to put on record the subjoined account of a fall of meteorites, that was reported in the *New York Times*, of November 5, 1906, a clipping from which paper I have just come across. The fall was observed from the Phoenix Line steamship "St. Andrew," en route from Antwerp to New York, on October 30, 1906, "about 600 miles northeast of Cape Race." The more

important parts of an interview with Chief Officer V. E. Spencer are here given.

On Tuesday (October 30) afternoon the weather was clear and bright, although there was little sunshine. Just after one bell, 4.30 o'clock, I saw three meteors fall into the water dead ahead of the ship, one after another at a distance of about five miles. Although it was daylight they left a red streak in the air from zenith to the horizon. Simultaneously the third engineer shouted to me. I then saw a huge meteorite on the port beam falling in a zigzag manner less than a mile away to the southward. We could distinctly hear the hissing of the water as it touched. It fell with a rocking motion, leaving a broad red streak in its wake. The meteor must have weighed several tons, and appeared to be from 10 to 15 feet in diameter. It was saucer-shaped, which probably accounted for the peculiar rocking motion.

When the mass of metal struck the water the spray and steam rose to a height of at least forty feet, and for a few moments looked like the mouth on a crater. If it had been night the meteor would have illuminated the sea for fifty or sixty miles. The hissing sound, like escaping steam, when it struck the water, was so loud that the Chief Engineer turned out of his berth and came on deck, thinking the sound came from the engine room.

Captain Russ, of the Hamburg-American steamer *Brazilia*, which arrived about the same time as the *St. Andrew*, reported having seen a large meteor at 7 P.M. on October 30, in Lat. 47° N., and Lon. 48°W. This is believed to have been a part of the intermittent meteoric shower observed by the *St. Andrew* earlier in the evening.

In this account, by an intelligent observer, and one presumably fitted by training and profession to observe rapidly, some points of special interest may be noted: the peltoid form, zigzag path, and rocking motion, it being noteworthy that the irregular path was maintained in spite of the very large size (probably overestimated) and great weight; the probably constant general orientation, ("Brustseite"); the brilliant light, though it is not stated whether this came from the meteor or from its track; the loudness of the hissing sound when it struck the water, sufficient to rouse the Chief Engineer a mile away. One is inclined to think that the meteorites were siderolites. It is, of course, purely conjectural whether the meteor reported by the *Brazilia* belonged to the *St. Andrew* shower; the difference in time would seem to be incompatible with this supposition, which may be put down to a reporter's love of the sensational.

HENRY S. WASHINGTON

GEOPHYSICAL LABORATORY,
CARNEGIE INSTITUTION OF WASHINGTON

MUSICAL NOTATION

TO THE EDITOR OF SCIENCE: In the September number of *The Scientific Monthly* Professor E. V. Huntington describes a new way of writing music, which for simplicity and clearness can hardly be surpassed. It consists in using the ordinary staff for the twelve notes of the tempered chromatic scale, instead of (as now done) for the seven notes of the diatonic scale. This new "normalized" notation does away with all sharps and flats. Since there are just twelve lines and spaces (including the added line below) in each staff, each letter will have always the same position on the staff, whether soprano, alto, tenor or bass. It is hoped that teachers will take advantage of the normalized notation to smooth out the road for beginners, particularly in the grade schools.

There is another unnecessary musical difficulty in the way of piano students, which can be easily removed. The pupil must now become familiar with twelve different modes of fingering, one for each of the twelve possible keynotes. This means that for the average pupil so much practise is required in order to become reasonably expert at the piano that he or she becomes discouraged. In any case a great deal of time is wasted in practising the twelve sets of finger exercises.

A very slight change in the keyboard will reduce the sets of fingering from twelve to two. The change consists in having six white keys and six black (instead of seven white and five black) in each octave. The key C, which would then be black, should be fluted or corrugated on its upper surface, so as to be easily recognizable both by sight and

by touch; and there should be a roughening or a longitudinal corrugation on F sharp, the middle note of the scale, for the same purpose.

A third advantage would result from these two changes. The lines on the staff, in the normalized notation, correspond to the black keys on the normalized keyboard; and the spaces of the staff to the white keys. If the page be turned so that the left side becomes the top the correspondence is perfect, each written note on the staff having its corresponding place on the keyboard. The physiological reflex between eyes and fingers to be established by the learner thus becomes as simple and direct as it is possible to make it. The time required to become moderately expert in sight reading and playing would then be reduced at least to half what it is now.

T. P. Hall
Vancouver, B. C.

PULSATION OF A CAT'S HEART AFTER DEATH

An interesting case of prolonged beating of a cat's heart after death came to the writer's attention a short time since. A cat was killed by the use of ether at 2:20 P.M. A short time afterwards the body was stretched on a window-sill out of doors where it stayed undisturbed, and to all appearances dead, until 3:30, when it was taken in to the laboratory and immediately skinned, and the thorax cut open exposing the pericardium and lungs. The student doing the dissecting, Mr. John M. Long, at once called the writer's attention to the fact that the right auricle (only) was beating in almost perfect rhythm, and with apparently considerable strength. This continued with only slight variation in rhythm until 3:56, when a small quantity of normal salt solution was poured over the pericardium. Beginning at this time, the pulsations began to lose their rhythm until at 4:03 the auricle was beating at the rate of three pulsations at normal speed followed by an interval of fourteen seconds, then again three beats, followed by the interval, and so on, both the heats and intervals being very regular. This continued for four minutes (until (4:07), when the number of pulsations was reduced to two instead of three, and the length of the interval began to vary from thirteen to eighteen seconds. More salt solutions was poured over the pericardium at this time, and at 4:18 the inferior vena cava was cut just above the diaphram. No change in the regularity of the pulsations was noticed from that recorded at 4:07 until the organ abruptly stopped beating at 4:44 P.M.

This gives a total length of time from the administration of the ether until the heart stopped beating of two hours and twenty-four minutes. Of course there must be subtracted a short period at the first when the cat was dying, but this still leaves something over two hours during which the auricle continued to beat after the death of the animal. During all this time no contraction was noticed in any part of the heart other than the right auricle. The pericardium was not opened until after the heart had ceased to beat. No electrical or mechanical means were used to stimulate the heart in any way, except the application of normal salt solution, as above mentioned. So far as the writer knows, this is the longest case on record of a cat's heart continuing to pulsate after death.

Horace Gunthorp
University of Washington,
Seattle, Wash.

STOCK CULTURES OF A PROTOZOON

During the course of investigation with Protozoa, a rather convenient and easy method of obtaining and keeping stock cultures of Colopoda was found.

Colopoda, as is well known, usually occur early in soil cultures from which they can be obtained, in the active state, in large numbers. Later in the life of the culture the animals encyst and it is upon this condition that the following method is based.

From a young soil culture active Colopoda are isolated, transferred to syracuse watch glasses and ordinary hay infusion added. After one or two days the culture fluid in the watch glass is allowed to evaporate slowly by leaving exposed to the air. During this slow

evaporation the animals encyst. The dried-up culture is left exposed for one or two days, when new hay infusion is added. The animals, having divided within the cysts, revive and are found in greatly increased numbers. This drying-up process can be repeated until a more or less concentrated culture of the organisms is obtained. The concentrated culture of organisms is then pipetted into a petri dish in which a piece of ordinary filtered paper, cut so as to exactly cover the bottom of the dish and moistened with hay infusion, is placed. The petri dish is then left uncovered to slowly evaporate. The filter paper, with the encysted organisms on it, when thoroughly dry can be cut into small pieces and kept indefinitely.

To start fresh cultures, pieces of the filter paper are put into watch glasses or other containers and hay infusion added. In a short time the animals revive and new cultures of the original are thus obtained.

This method of keeping stock cultures seems to be especially adapted for schools and colleges where only a limited amount of time is devoted to the Protozoa and where no time for the ordinary culture preparation work is available.

JOSEPH H. BODINE
ZOOLOGICAL LABORATORY,
UNIVERSITY OF PENNSYLVANIA

QUOTATIONS

THE BRITISH COMMITTEE FOR AIDING MEN OF LETTERS AND SCIENCE IN RUSSIA[1]

WE have recently been able to get some direct communication from men of science and men of letters in North Russia. Their condition is one of great privation and limitation. They share in the consequences of the almost complete economic exhaustion of Russia; like most people in that country, they are ill-clad, underfed, and short of such physical essentials as make life tolerable.

Nevertheless, a certain amount of scientific research and some literary work still go on. The Bolsheviks were at first regardless, and even in some cases hostile, to these intellectual workers, but the Bolshevik government has apparently come to realize something of the importance of scientific and literary work to the community, and the remnant—for deaths among them have been very numerous—of these people, the flower of the mental life of Rusia, has now been gathered together into special rationing organizations which ensure at least the bare necessaries of life for them.

These organizations have their headquarters in two buildings known as the House of Science and the House of Literature and Art. Under the former we note such great names as those of Pavlov the physiologist and Nobel prizeman, Karpinsky the geologist, Borodin the botanist, Belopolsky the astronomer, Tagantzev the criminologist, Oldenburg the Orientalist and permanent secretary of the Petersburg Academy of Science, Koni, Bechterev, Satishev, Morozov, and many others familiar to the scientific world.

Several of these scientific men have been interviewed and affairs discussed with them, particularly as to whether anything could be done to help them. There were many matters in which it would be possible to assist them, but upon one particular they laid stress. Their thought and work are greatly impeded by the fact that they have seen practically no European books or publications since the Revolution. This is an inconvenience amounting to real intellectual distress. In the hope that this condition may be relieved by an appeal to British scientific workers, Professor Oldenburg formed a small committee and made a comprehensive list of books and publications needed by the intellectual community in Russia if it is to keep alive and abreast of the rest of the world.

It is, of course, necessary to be assured that any aid of this kind provided for literary and scientific men in Russia would reach its destination. The Bolshevik government in Moscow, the Russian trade delegations in Reval and London, and our own authorities have therefore been consulted, and it would appear that there will be no obstacles to the transmission of this needed material to the House of Science and the House of Literature and Art. It can be got through by special facilities even

[1] From *Nature*.

under present conditions. Many of the publications named in Professor Oldenburg's list will have to be bought, the costs of transmission will be considerable, and accordingly the undersigned have formed themselves into a small committee for the collection and administration of a fund for the supply of scientific and literary publications, and possibly, if the amount subscribed permits of it, of other necessities, to these Russian *savants* and men of letters.

We hope to work in close association with the Royal Society and other leading learned societies in this matter. The British Science Guild has kindly granted the committee permission to use its address.

We appeal for subscriptions, and ask that cheques should be made out to the Treasurer, C. Hagberg Wright, LL.D., and sent to the British Committee for Aiding Men of Letters and Science in Russia, British Science Guild Offices, 6 John Street, Adelphi, London, W.C.2.

MONTAGUE OF BEAULIEU,
ERNEST BARKER,
E. P. CATHCART,
A. S. EDDINGTON,
I. GOLLANCZ,
R. A. GREGORY,
P. CHALMERS MITCHELL,
BERNARD PARES,
ARTHUR SCHUSTER,
C. S. SHERRINGTON,
A. E. SHIPLEY,
H. G. WELLS,
A. SMITH WOODWARD,
C. HAGBERG WRIGHT.

SPECIAL ARTICLES

STAR-TIME OBSERVATIONS WITH AN ENGINEER'S Y-LEVEL

DESIRING a check on a pendulum clock belonging to the Physics Department of the University of the Philippines. independent of the time-ball of the Manila Observatory, I have been led to use the following makeshift device.

In Fig. 1, O is the objective of an engineer's Y-level; B_1 a wooden block fitted over the objective, with a hole bored through; B_2 a small piece of board nailed to the block B_1; P is a 45° 1-inch prism fastened to B_1; L is

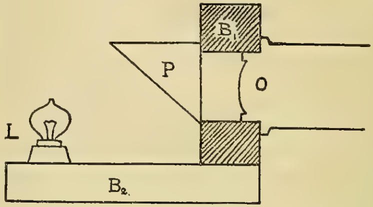

FIG. 1.

a small electric lamp. The whole attachment is tilted forward a little so that when the axis of the telescope is horizontal axial rays do not come by reflection from the zenith, but from a point about 2° or 3° from the zenith. Stray light from the little lamp L illuminates the fields so that the cross hairs are clearly seen. Two somewhat stale dry cells on the floor give enough light, but not so much as to drown the image of a fourth magnitude star. A small switch is included in the circuit.

When the instrument is set up and levelled, with no current on, the images of stars about 2° to 4° from the zenith are seen in different parts of the field; if the telescope is rotated about the vertical axis these images describe arcs of circles across the field, Fig. 2. If these arcs have horizontal chords from side to side of the circular field, Fig. 3, the prism is adjusted, *i.e.*, the rays coming down to the prism, their reflections into the telescope, and the vertical axis of rotation are in the same

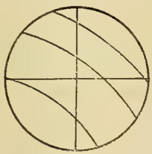

FIG. 2.

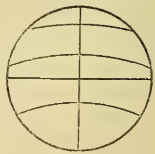

FIG. 3.

plane. This adjustment is convenient, but can not be made very exact; it is done by

twisting B_1 around the objective mounting, and noting the results. As the field is dark, quite faint stars serve.

Before use the level was carefully calibrated.

An observation is made by setting the telescope, pointing east, so that the image of a known star passes the intersection of the cross-hairs, starting a stopwatch, stopping the watch by a clock, reading both ends of the bubble; then pointing west and repeating. This gives the instants of two passages of the star across a small horizontal circle of about 2° or 3° radius; the mean of these is the clock time of transit over the meridian. If there is a change in level reading, this is allowed for by the formulas for the method of equal altitudes, *e.g.*, Comstock's "Field Astronomy," par. 64, equations (108) and (109). As but one star is used, the correction terms depending on declination vanish. Of course the best results are obtained with stars which pass very near the zenith, they being very near the prime vertical. The computations are almost as simple as those with a meridian transit instrument. With the arrangement used, the interval between upward and downward passages is about 16 minutes.

At Manila ten or twelve of the ten-day stars in the American Ephemeris are bright enough and culminate near enough to the zenith for this apparatus. I have made a good many trials, of which a large number were unsatisfactory, the concrete sidewalk on which the tripod stood, and on which I had to move about from one sighting or reading position to another, not being stable enough. However, a position was found where the bubble moved from this cause only an uncertain fraction of a division, and the results in the table were there obtained.

The columns marked "corrections for star time—time-ball time" give the corrections to be added to the time-piece reading, found as above, to give the standard mean time (E. 120°), computed from the geographical position (known to 0.1 sec.), and the star tables, or the same interpolated from the noon-time fall of the Manila Observatory time-ball. As is to be expected, the latter correction is generally found to be smaller, for the time-ball has to drop a short distance for its motion to be perceived.

Taking into consideration the clumsiness of the attachment, the uncertainties of stopwatch readings, the instability of the platform and the inexperience of the observer, the table indicates that under better conditions the method would be exact. It has the great advantage that highly accurate adjustments of collimation axis, etc., are unimportant. It can be extended by observing pairs of stars to give latitude as well as time.

TABLE I

		Correction for		Dif.
		Star Time	Time-ball Time	
1919, XI., 4 ..	γ Pegasi	− 6.95	− 7.5	+0.55
1919, XI., 4 ..	η Piscium	− 6.7	− 7.3	+0.6
1919. XI., 5 ..	γ Pegasi	− 6.4	− 8.2	+1.8
1919, XI., 5 ..	η Piscium	− 7.0	− 8.2	+1.2
1919, XI., 8 ..	γ Pegasi	−10.1	−10.7	+0.6
1919, XI., 9 ..	α Pegasi	+16.8	+16.1	+0.7
1919, XI., 9 ..	γ Pegasi	+17.1	+16.1	+1.0
1919, XI., 9 ..	η Piscium	+16.7	+16.1	+0.6
1919. XI., 9 ..	σ Arietis	+16.1	+16.1	+0.0

WILLARD J. FISHER
THE UNIVERSITY OF THE PHILIPPINES,
MANILA, P. I.

THE AMERICAN SOCIETY OF NATURALISTS

THE thirty-eighth annual meeting of the American Society of Naturalists was held in Ida Noyes Hall and Mandel Hall, University of Chicago, December 30 and 31, 1920.

At the business meeting the treasurer's report was read, showing a balance of $514.09 in the treasury.

On recommendation of the executive committee, the constitution was amended by adding a sentence to the end of Section 1 of Article II. This section now reads:

Section 1. Membership in this society shall be limited to persons professionally engaged in some branch of natural history, as, instructors in natural history, officers of museums and other scientific institutions, physicians, and others, who have essentially promoted the natural history sciences by original contributions of any kind. Any member may present to the executive committee of the society, through the secretary, names of candidates

for membership, and those candidates who are approved by the committee may be elected to membership in the society by a majority of the members present at any meeting of the society. A nomination for membership in the society shall remain in the hands of the executive committee for at least one year before action is taken upon it. The names of candidates not elected to membership within three years of the date of consideration shall be removed from the list of nominees unless renominated.

Professor H. H. Bartlett, University of Michigan, was elected to represent the society on the board of control of Botanical Abstracts, to succceed Professor E. M. East. Dr. J. Arthur Harris is the other representative of the society on the board of control.

Professor Leon J. Cole was elected to membership for a term of five years, in the advisory committee of the society, related to the committee on cooperation and coordination of the Division of Biology and Agriculture of the National Research Council, to succeed Dr. A. G. Mayor. The other members of this advisory committee are Bradley M. Davis (4 years, chairman), Ross G. Harrison (3 years), George H. Shull (2 years), and H. S. Jennings (1 year).

The report of the committee on genetical form and nomenclature, authorized at the 1919 meeting of the society, was read, in the absence of the chairman, Dr. C. C. Little, by Dr. Sewall Wright. The society voted to continue the committee and to request it to publish the report in SCIENCE, but deferred discussion of and action upon the report to a later meeting.

The following persons, recommended to the society by the executive committee for election to membership, were duly elected: William H. F. Addison, Roy E. Clausen, Theodore D. A. Cockerell, Frederick V. Coville, George W. Crile, John W. Gowen, A. L. Hagedoorn, Duncan Starr Johnson, William Allen Orton, Charles Vancouver Piper, Harold H. Plough, Brayton Howard Ransom, Mary B. Stark, George L. Streeter, Walter T. Swingle.

The nominating committee presented candidates for vacancies in the offices of president, vice-president and treasurer, who were unanimously elected by the society. Accordingly, the officers for the year 1921 are as follows:

President: Professor Bradley M. Davis, University of Michigan.

Vice-president: Professor Henry E. Crampton, Columbia University.

Secretary: Professor A. Franklin Shull, University of Michigan.

Treasurer: Dr. J. Arthur Harris, Carnegie Institution of Washington.

Additional members of executive committee by virtue of previous office: Professor W. E. Castle, Harvard University; Professor E. M. East, Harvard University; Dr. Jacques Loeb, Rockefeller Institute for Medical Research.

The annual dinner of the society was held at the Hotel Sherman, at 7 o'clock, December 30, with one hundred and thirty-nine in attendance. In the absence of the president, Dr. Jacques Loeb, the after-dinner addresses were made by two charter members, Professors William North Rice and J. Sterling Kingsley, who narrated the story of the foundation and early days of the society.

The program of papers, which occupied Thursday and Friday, December 30 and 31, was as follows:

Thursday morning:

The analysis of a continuously varying character in the wasp Hadrobracon: P. W. WHITING.

Fluctuations of sampling in a population showing linkage: J. A. DETLEFSEN.

Linkage between flower color and stem color in Œnothera: GEORGE H. SHULL. (Read by title.)

The inheritance and linkage relation of shrunken endosperm in maize: C. B. HUTCHISON (introduced by R. A. Emerson).

Relative frequency of crossing-over in microspore and megaspore development in maize: R. A. EMERSON AND C. B. HUTCHISON.

Types of mutation and their possible significance in evolution: A. F. BLAKESLEE.

Linkage of tunicate ear and sugary endosperm and their genetic relations to other maize characters: W. H. EYSTER (introduced by R. A. Emerson).

A case of maternal inheritance in maize: E. G. ANDERSON AND L. F. RANDOLPH (introduced by R. A. Emerson).

I. *Genetic aspects* (Dr. Anderson). II. *Cytological relations* (Mr. Randolph).

Thursday afternoon: Symposium on *General Physiology.*

On the photochemistry of the reactions of animals to light: SELIG HECHT.

The influence of internal secretion on the development and growth of amphibians: E. UHLENHUTH.

The rôle of the hydrogen ion concentration in life phenomena: WM. MANSFIELD CLARK.

The mechanism of injury and recovery of the cell: W. J. V. OSTERHOUT.

Enzyme action as exemplified by pepsin digestion: JOHN H. NORTHROP.

The equilibrium functions of the internal ear: S. S. MAXWELL.

Friday morning:

Differential survival of male and female dove embryos in increased and decreased pressures of oxygen: a test of the metabolic theory of sex: OSCAR RIDDLE.

A decrease in sexual dimorphism during the course of selection with inbreeding: CHARLES ZELENEY.

A dominant color mutation of the guinea-pig: SEWALL WRIGHT.

Some conclusions regarding the influence of the endocrine glands upon amphibian development: BENNET M. ALLEN.

Chromosomes and the life cycle of Hydatina senta: A. FRANKLIN SHULL.

Inheritance of eye-defects induced in rabbits: M. F. GUYER AND E. A. SMITH.

The bearing of Mendelism and mutation on the theory of natural selection: C. C. NUTTING.

The inheritance of size in rats: HEMAN L. IBSEN.

Inheritance of a secondary sexual character and the effects of lethal factors in Colias philodice: JOHN H. GEROULD. (Read by title.)

A recessive mutation in haemolymph pigment in Colias philodice: JOHN H. GEROULD. (Read by title.)

Duplicate factors for cotyledon color in soy beans: C. M. WOODWORTH (introduced by J. A. Detlefsen).

Some variation in color pattern of mammals: LEON J. COLE AND JESSIE MEGEATH.

Inheritance of checks and bars in pigeons: SARAH V. H. JONES (introduced by Leon J. Cole).

Friday afternoon:

Selective fertilization and the rate of pollen tube growth: D. F. JONES.

Genetic studies in Crepis: E. B. BABCOCK.

A quantitative study of mutation in the second chromosome of Drosophila: H. J. MULLER.

A genetic analysis of "low crossover stock" produced by selection: ELMER ROBERTS (introduced by J. A. Detlefsen).

The inheritance of small deviations from bilateral symmetry: F. B. SUMNER. (Read by title.)

Relation between chaff color and pubescence in a cross between wheat and emmer: H. H. LOVE. (Read by title.)

The mutant type "crossveinless" in Drosophila virilis and D. melanogaster: ALEXANDER WEINSTEIN AND C. B. BRIDGES.

A. FRANKLIN SHULL,
Secretary

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE American Society of Zoologists held its eighteenth annual meeting at the University of Chicago in conjunction with Section F of the American Association for the Advancement of Science and in association with other biological societies on December 28, 29 and 30, 1920.

Due the absence of the secretary, H. V. Neal was elected secretary *pro tem.*

The Constitution was amended by adding a new type of membership as follows:

Foreign zoologists, not members of this Society, may be elected Honorary Fellows upon unanimous recommendation of the Executive Committee by a majority vote of the members present at any meeting of the Society. Honorary Fellows shall not be required to pay dues.

The By-Law providing for affiliation with the American Society of Naturalists was amended to eliminate this affiliation.

The following were elected to membership in the Society: Royal N. Chapman, University of Minnesota; James Arthur Dawson, Dalhousie University; Leslie Clarence Dunn, Connecticut Agricultural Station; Ernest Melville DuPorte, MacDonald College; Charles McLean Fraser, University of British Columbia; William Marion Goldsmith, Southwestern College; Norman McDowell Grier, Washington and Jefferson College; Selig Hecht, Creighton Medical College; Walter N. Hess, DePauw University; Minna E. Jewell, Milwaukee-Downer College; Thestle T. Job, Loyola University School of Medicine; Rokusaburo Kudo, University of Illinois; Ralph S. Lillie, Department of Pure Science, Nela Research Laboratories; William A. Lippincott, Kansas State Agricultural College; Henry G. May, Rhode Island State College and Agricultural Experiment Station; Irene McCullough, Sophie Newcomb College; Richard Anthony Muttkowski, University of Idaho; J. M. D. Olmstead, Toronto University; Thomas Elliott Snyder, Bureau of Entomology U. S. Department of Agriculture; Wilbur Willis Swingle, Yale University; Charles Vincent Taylor University of California; Clarence Lester Turner, Beloit College; Asa Orrin Weese, University of New Mexico.

Among other items the secretary reported the death of two members, E. L. Michael and George D. Allen. The membership roll before the election of new members contained 305 names of members in good standing. The American Association for the Advancement of Science had recognized election to membership in the society as a certification of eligibility for Fellowship in the association.

The report of the treasurer showed a probable balance for January 1, 1921, of $890.30, a net increase for the year of $80.71.

The officers elected for 1921 are: *President*, C. A. Kofoid; *Vice-president*, A. L. Treadwell; *Member of the Executive Committee to serve five years*, Gilman A. Drew; *Member of Division of Biology and Agriculture, National Research Council, to serve three years*, William Patten; *Members of the Council of the American Association for the Advancement of Science*, C. C. Nutting and W. C. Allee; *Members of the Advisory Board to serve four years*, C. A. Kofoid and D. H. Tennent.

Professor R. A. Budington appealed for support for Professor Van der Stricht and his *Archiv de Biologie* which can be given by the purchase of a set of lantern slides made from Van der Stricht's preparations showing fertilization in *Nereis*.

RESOLUTIONS ADOPTED REGARDING DUTY FREE IMPORTATION OF SCIENTIFIC MATERIALS

The American Society of Zoologists representing the zoological interests of the country, especially from the standpoint of research and instruction in our American colleges and universities, views with much concern the proposals made in the bill H. R. 7785 which provides for an increase of 20 per cent. in the duty on scientific instruments and an increase of 30 per cent. on scientific glassware and in addition repeals section 573 of the tariff act of October 3, 1913, which allows for the duty free importation of such materials by educational institutions.

In view of the fact that the great mass of research in pure science is still carried on by men in our colleges and universities, an increase in the cost of scientific apparatus and equipment is especially to be deplored since even under the present arrangement of low duties and duty free import privileges, the funds at the disposal of our educational institutions are inadequate to provide for the most efficient teaching equipment or to allow for the most effective prosecution of research.

Therefore be it resolved: That the American Society of Zoologists, assembled in annual session, call the attention of Congress to the burden imposed upon the prosecution of educational and research work by the proposed repeal of the privilege of duty free importation of scientific apparatus, chemicals and glassware by educational institutions and respectfully request the continuance of this privilege in proposed tariff legislation.

The American Society of Zoologists also requests the restoration of the privilege of the duty free importation of single copies of scientific books in the English language by members of recognized educational and scientific institutions.

That copies of these resolutions be forwarded to the Congressional Committees concerned, the National Academy of Sciences, the National Research Council and to the executive committee of the American Association for the Advancement of Science and g'ven other proper publicity as the executive committee of the American Society of Zoologists shall direct.

CONCERNING THE PRESERVATION OF WILD LIFE

WHEREAS: The Ecological Society of America is engaged in attempting to secure the reservation of natural areas, *i.e.*, reserves including the original flora and fauna in an undisturbed state, for research present and future. A standing committee has been listing and describing such areas desirable for reservation, during several years past. The society is now entering on a plan to unite the various groups interested in primeval areas, namely:

1. Investigators in biology, geography, history and art.
2. Sportsmen through their interest in game sanctuaries.
3. Ornithologists through their interest in bird refuges.
4. Wild flower lovers through their interest in primeval areas as seeding centers and preserves.

The purpose of such union of interest will be to secure the preservation of natural areas in state parks, forest preserves, etc., and to secure the creation of more such parks and forest preserves.

WHEREAS: The number of primeval preserves especially in the eastern states is wholly inadequate for either present or future research purposes and areas from which such preserves may be created are rapidly being destroyed.

Be it resolved: That the American Society of Zoologists indorses the efforts of the Ecological Society of America to secure reserves for research purposes and directs its secretary to forward a copy of this resolution to the division of Biology and Agriculture of the National Research Council.

And further resolved: That the president of the society be directed to appoint a delegate to the Parks Conference to be held in Des Moines, Iowa, January 10, 11 and 12, 1921, said delegate to represent the society in the interest of reserves of primeval conditions for zoological research.

A more complete report of the business transacted together with titles and abstracts of the papers presented and a revised list of members of the society will be found in the *Anatomical Record* for January, 1921.

W. C. ALLEE,
Secretary-Treasurer

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SAMUEL JAMES MELTZER[1]

Dr. Samuel James Meltzer was born in Curland, northwestern Russia, March 22, 1851. He received his preliminary education in a Real Gymnasium in Königsberg and his later training in the University of Berlin where he graduated in medicine in 1882. After taking his medical degree he decided to make his career in America, as the country which in his opinion had the best form of government. He had not sufficient means to make the journey and was therefore obliged to secure a position as ship's surgeon on one of the transatlantic vessels. On arriving in New York it was necessary in the beginning to devote his time mainly to building up a practise sufficient to support his family, but almost from the beginning he made arrangements also to give part of his time to research. From that period until his death on November 7, 1920, in his seventieth year he was a tireless investigator. When in the course of time the opportunity came to him from the Rockefeller Institute to give his time entirely to research he did not hesitate in making his decision. At a considerable financial sacrifice he abandoned his medical practise to devote himself to the kind of work that he most loved and most valued. By his good work and his high character he attained a position of honor and distinction in American medicine and endeared himself to his fellow-workers in all parts of the country. His productivity was remarkable. The list of his published papers includes over two hundred and forty titles, distributed among some forty-eight scientific journals of this country, Germany and England. These papers contain contributions to the subjects

[1] Read before the Federation of American Societies for Experimental Biology, Chicago, December 28, 1920.

of physiology, pharmacology, pathology and clinical medicine together with a number of lectures and general addresses. That he was an investigator of recognized standing in these several branches of medicine and was regarded as a valued contributor to so many scientific journals of the first rank is a striking demonstration of the breadth of his interests and knowledge. He was a member of twenty or more national scientific or clinical societies and in all of them it may be said he was prepared to take his part as an expert in the reading and the discussion of technical papers.

He served as president of the American Physiological Society, the Society for Experimental Biology and Medicine, the American Gastro-enterological Society, the American Society for the Advancement of Clinical Research, the Association of American Physicians and the American Association for Thoracic Surgery. The membership in these societies is composed of trained specialists. It is their custom to choose as their presiding officer only those who have made contributions of distinction to the subject to which the society is devoted. It seems to me unique in the modern history of medicine for one man to have received such special recognition from technical workers in so many different fields.

While his activities covered this large range he was interested primarily in physiology. "I belong," he said in a recent paper "to those who believe . . . that the knowledge of physiology is of special importance to clinical medicine." His work in this field entitles him certainly to be ranked among the foremost American physiologists. In attempting to present some estimate of the results of his labors I must limit myself mainly to his physiological activity. Indeed in this subject alone his papers are so varied that it will be possible to bring under review only what seem to be his major contributions. His first appearance as an investigator is recorded in a brief note in the *Proceedings* of the Berlin Physiological Society, May 14, 1880. In this note it is stated that Professor Kronecker exhibited a dog in which Herr Cand. Med. Meltzer had cut the nerves going to the mylohyoid muscle and thus demonstrated the importance of this muscle in the initial stage of swallowing. At a later meeting of the society in the same year Kronecker presented the full results of an investigation carried out by Herr Cand. Med. Meltzer under his supervision on the "Process of Swallowing." This paper was published subsequently by Kronecker and Meltzer in the *Monatsbericht der Königl. Akademie der Wissenschaften zu Berlin,* 1881. In this important contribution the mechanism of swallowing was given an entirely new interpretation which has since been generally accepted and is known as the Kronecker-Meltzer theory of deglutition. Meltzer had attracted Kronecker's attention while a student in his course. Out of this acquaintanceship developed an invitation to engage in a research and eventually a warm friendship between the two men that lasted throughout life. Meltzer's career was thus determined while still a student of medicine. Kronecker's influence attracted him to physiology and set his feet in the paths of research. The investigation in which they collaborated was important and original—just what part each contributed it is not now possible to discover, but it is interesting to find that this initial venture into research furnished a motif which can be detected recurring again and again in Meltzer's subsequent work. A companion paper upon "Die Irradiationen des Schluckcentrums und ihre Bedeutung" was published by Meltzer alone in 1883. It is a very suggestive paper on account of the careful analysis it contains of the far-reaching and curious effects in the central nervous system of the act of swallowing and also because in it Meltzer announces certain views upon the importance of the inhibitory processes which subsequently formed the basis of his theory of inhibition, and remained with him throughout life as a sort of compass by which to set his course on his voyages of discovery. He calls attention in this work to the fact that reflex excitation of the inspiratory muscles is accompanied by reflex in-

hibition of the expiratory muscles and vice versa, and he goes on to make the suggestion that a similar relationship must prevail in the case of all antagonistic muscles such as the extensors and flexors of the limbs. Some ten years later Sherrington gave the necessary demonstration that this interrelation does hold with the muscular antagonists, that the contraction of the one is accompanied by the inhibition of the other and he designated this relationship under the term of "reciprocal innervation." Meltzer meanwhile had been accumulating instances of this combined action of excitation and inhibition, but he neglected at that period to apply a distinctive name to this kind of correlated activity. There can be no doubt that when it is possible to label an idea with an appropriate designation its currency in the scientific world is greatly facilitated. In his paper on "The Self-Regulation of Respiration" read before the American Physiological Society in 1889 and published in the *New York Medical Journal* and under a different title in the *Archiv. für Physiologie* he describes experiments intended to show that two kinds of afferent fibers exist in the vagus nerve, one exciting and the other inhibiting inspiratory movements. He used this fact to modify the Hering-Breuer theory of the self-regulation of the respirations by assuming that the expansion of the lungs stimulates both groups of fibers. The resultant effect, as in the case of the simultaneous stimulation of the motor and inhibitory fibers to the heart, is a dominance of the inhibitory effect, thus cutting short the inspiration and bringing on an expiration. But after the inhibition ceases the excitatory fibers, which, like the acceleratory fibers of the heart have a long after action, come into play and start a new inspiration. In his first general paper on inhibition this idea of a combined action of opposing processes is extended by the citation of numerous instances taken from physiological literature and is expanded into a general theory which makes inhibition a universal property of irritable tissues.

"I entertain and defend the view that the phenomena of life are not simply the outcome of the single factor of excitation, but they are the result of a compromise between two antagonistic factors, the fundamental forces of life, excitation and inhibition."

That is to say, whenever a tissue is stimulated two different processes are aroused, one leading to functional activity and one to a suppression of activity. As to the nature of these processes very little is said. He was not satisfied with the Hering-Gaskell conception that excitation follows or is an accompaniment of catabolic changes while inhibition is due to processes of an anabolic or assimilative character. He goes only so far as to assume that both processes are concerned with the kinetic and potential energies of the system, that excitation facilitates the conversion of potential to kinetic energy while inhibition hinders or retards this conversion, like the turning off or on of a stopcock. Nor was he satisfied with Sherrington's term of reciprocal innervation to describe all of the phenomena he had in mind. While this phrase is a suitable designation for the relationship between physically antagonistic muscles such as the flexors and extensors it is less appropriate in other cases, for example the simultaneous phases of contraction and inhibition exhibited in peristalsis. In later papers he suggested first the term *crossed innervation* borrowed from von Basch, but subsequently adopted the designation of *contrary innervation* as more applicable to the whole series of phenomena which he was considering. This process he believed is universal in its action—it is "manifest in all the functions of the animal body." Moreover his experience and observation as a practising physician led him to believe that "a disturbance of this law is a factor of more or less importance in the pathogenesis of many disorders and diseases of the animal body." In this way he would explain in part at least the muscular incoordination in tabes and the gastric crises of that disease, as well as gastric and intestinal colic in general. If the orderly sequence of a peristaltic wave is

disturbed so that the advancing wave of contraction meets a contracted instead of an inhibited area conditions are present which may well bring about a distension sufficient to account for the pain of colic. He gives many other illustrations of pathological conditions which may find a plausible explanation on the assumption of a disorder or disharmony in the law of contrary innervation. How far Dr. Meltzer was correct in the applications of his theory it is not possible to say. In all probability some of the specific instances that he cites in support of his views are amenable now to other explanations. But it is a fact, I believe, that he was much in advance of his earlier contemporaries in the emphasis he placed upon the significance of inhibition in the general activities of the body. The story is far from being told but it may be said that physiological thought since 1883 has tended more and more toward some such general conception of the rôle of inhibition as was in Meltzer's mind. For him at least it was a rewarding theory, it played, as he expressed it, a dominating part in all of his researches. One can not wholly appreciate his work nor understand his position on controversial points unless this attitude is born in mind. His theory of shock for example to which he held tenaciously was that "the various injuries which are capable of bringing on shock do so by favoring the development of the inhibitory side of all the functions of the body." There is a shifting of the normal balance toward the side of inhibition.

The most important of his contributions in later years will be found in three series of researches, one dealing with the action of adrenalin upon the blood-vessels and the pupillary muscles; one with the inhibitory action of magnesium sulphate and the antagonistic effect of the calcium salts, and one with the development of his method or artificial respiration by pharyngeal and intratracheal insufflation. The first series consists of eight or nine papers, mostly in collaboration with his daughter. They showed in this work that the temporary action of adrenalin upon the blood-vessels may be converted into a long-lasting effect, in the case of the ear-vessels, if these vessels are first denervated by section of the vaso-motor fibers in the sympathetic and the third cervical nerve. A more striking result still was obtained for the iris. In the mammal subcutaneous injections of adrenalin in moderate doses have no effect upon the size of the pupil, but if the superior cervical ganglion is first excised then, after a certain interval, subcutaneous injections bring on a marked and long-lasting dilatation. His explanation of these phenomena was made in terms of his theory of inhibition. Whether or not his views in regard to the relations of the cervical ganglion to pupillary dilatation will stand the test of future experimental work it is to be noted that the observation itself constitutes a significant instance of a kind of independent physiological activity on the part of a peripheral ganglion. The bearing of these facts upon the prevalent conception of the rapid destruction of epinephrin in the tissues was brought out especially in a paper with Auer in which it was shown that if adrenalin is injected into a ligated limb and an hour or so afterward the ligature is removed the dilatation of the pupil quickly follows, thus demonstrating that for this long period the adrenalin had remained unaffected by the tissues. Incidental results of this series of experiments were his discovery of the use of the frog's eye as a biological reagent for the detection of small concentrations of epinephrin and the rapidity of absorption in intramuscular as compared with subcutaneous injections.

The work upon the inhibitory and anesthetic effects of magnesium salts gave rise to no less than twenty five papers, most of them published in collaboration with one or another of his associates but chiefly with Dr. Auer. The peculiar inhibitory action of magnesium sulphate had attracted his attention as far back as 1899, and he reported upon it incidentally in a communication to the American Physiological Society. But in 1904–05, influenced again by his general conception of the importance of the inhibitory

processes he took up with Auer a careful physiological study of its action. The results were most interesting and important. When given subcutaneously in certain doses the magnesium sulphate produces a condition of complete unconsciousness and muscular paralysis or relaxation, which is reversible, in the sense that when the animal is given proper care it recovers. Later he was able to show that out of this condition of profound depression or inhibition the animal may be restored to complete consciousness and motility with miraculous suddenness by the intravascular injection of small amounts of calcium chloride. No one who was fortunate enough to see this demonstration as given by Dr. Meltzer will forget its dramatic effect upon his audience. A healthy vigorous rabbit was brought quickly to a condition of complete immobility and apparent death by the magnesium sulphate and then even more suddenly raised from the dead and restored to its normal tranquil existence by the injection of some calcium chloride. Meltzer and his collaborators investigated various phases of this action of magnesium sulphate and all of the results obtained tended to strengthen in his mind the conviction that in magnesium he had discovered the element in the body that is especially concerned in the processes of inhibition. The antagonistic action of the calcium although exhibited in such a striking way was not in his opinion specific. His own experiments in connection with the results reported by other observers led him to the general view that calcium serves to balance the abnormal activity of the other kations, potassium, sodium and magnesium, whether this abnormal action is in the direction of excitation or of inhibition. Modern work upon the physiological significance of the inorganic constituents of the body fluids which was begun in Ludwig's laboratory, but was given its main inpetus by the striking contributions of Ringer had concerned itself chiefly with the salts of potassium, sodium and calcium, which alone seemed to be sufficient to maintain normal conditions of irritability. Meltzer's work has shown that magnesium also has its place in this ancient balance of powers through which the functional activity of protoplasm is controlled. One can understand that in arriving at these results he must have felt that he was approximating at least a demonstration of the correctness of his general conception of the rôle of inhibition in functional activity. In this as in all of his experimental work Meltzer was eager to give his results a practical application to the art of medicine. The possibilities of the use of magnesium salts as an anesthetic agent in surgical operations were tested with some success on human beings and more important still its efficacy in controlling the spasms of tetanus has had a wide and promising application.

His last extensive series of researches dealt with anesthetization and artificial respiration through pharyngeal and intratracheal insufflation. Something like twenty-eight papers, most of them in collaboration with pupils or assistants, were devoted to this subject. His interest in this topic seems to have been stimulated by the fact that in his use of magnesium sulphate for anesthetic purposes the chief danger lay in the inhibition of the activity of the respiratory center. To meet this difficulty he undertook a study of the methods of artificial respiration. The initial paper in 1909 by Meltzer and Auer described a method of artificial respiration by continuous insufflation of the lungs through a tracheal catheter. It was found that by this means not only could an animal be kept alive without the action of the respiratory movements to fill and empty the lungs, but that it furnished also a convenient and efficient method for anesthetization. The use of this method in animal experimentation and especially its use in human surgery of the thorax and facial region was apparent and on many occasions Meltzer sought to make known its advantages and to ask for an adequate trial of its merits at the hands of the practical surgeons. The method has found some acceptance and the application of the principle involved will no doubt be extended in the future as the technique of thoracic surgery improves. It was

in recognition of the importance of this work that the American Association for Thoracic Surgery asked him, a physician and laboratory worker, to serve as their first president. It was natural that this work should have led him to consider the whole matter of artificial respiration in its relations to resuscitation after accidents of various sorts. His general paper in the *Medical Record* for 1917 giving a history and critical anlysis of the methods of resuscitation is an interesting and valuable contribution. He gives experimental data to prove that his device of intratracheal insufflation is the most efficient method of artificial respiration both for man and animals. But he realized that it is a method which requires special knowledge and training for its successful execution, and his broadening acquaintance with and interest in the practical aspects of resuscitation led him to experiment with the less efficient and less safe method of pharyngeal insufflation. He was a member of the three national commissions on resuscitation and served as chairman of the third commission. In connection with the duties of this service he devised a simple portable form of apparatus for pharyngeal insufflation which can be used with very little previous instruction and he demonstrated, with entire success I believe, that this form of apparatus is much more efficient than any of the so-called manual methods of resuscitation, or than any of the special machines for this purpose, pulmotors and lungmotors, which have been exploited commercially during the past few years. It was, I imagine, a sore disappointment to him that he was not able to convince his colleagues on the third commission that this apparatus met all the requirements for industrial and military use. It is probably the simplest and best instrument yet devised for artificial respiration as applied to man, and in institutions or industrial establishments where the need for artificial respiration may arise frequently and where special individuals may be instructed in its use it can be employed to great advantage. But it does require some little amount of training to use it properly—the average uninstructed man or woman can not be trusted to apply it intelligently, and for this reason the commission felt that it was wise to urge adoption of a manual method as the form of first aid which may be applied most successfully under ordinary conditions.

While the researches that I have attempted to summarize represent his most important contribution to physiological science, Dr. Meltzer kept in close touch with the progress in almost all branches of experimental medicine. He gave evidence of this interest in the publication of occasional papers on various topics or in articles of a general character. Shock, cardiac arrhythmias, therapeutics of self-repair, hemolysis, thyroid therapy, edema are among the subjects upon which he wrote, but probably the most original and helpful of his general papers is his well-known Harvey Lecture, 1906, on "The Factors of Safety in Animal Structure and Animal Economy." He applied this engineering term in a convincing way to describe the reserve powers possessed by many of the mechanism of the body. Doubtless the general conception involved had occurred to many others, but no one before him, so far as I know, had developed the idea so comprehensively and made of this provision a leading factor in the adaptation of the economy to its environment. The happy phrase that he employed served to precipitate the loose thought upon the subject, and its frequent recurrence since in medical literature is proof that the conception which it expresses has found wide acceptance in scientific circles. It is evident that his own thoughts were turned in this direction by the work of Chittenden upon the minimum protein diet. While he accepted, of course, the facts demonstrated by this observer in regard to the possibility of maintenance upon a low protein diet he was not willing to believe that a minimum diet is also an optimum diet in relation to the various metabolic stresses to which the body may be subjected. The experiences of the great war may serve to show that he was correct in taking this position.

To do full justice to the influence exerted upon contemporary medical research by Meltzer's work would require a careful analysis of the entire medical literature of the period, for, as I have tried to indicate, his sympathies were very broad and his activity was great. In some measure, either as interpreter or contributor, this influence was felt at many of the points of contact between medical science and medical practise. The border land between these subjects was in fact his special field of work. He had the spirit and ideals of the scientist, and knew at first hand what research work really means. He had experienced the labor and care and devotion required of those who aspire to increase knowledge. On the other hand he had a personal realization of the difficulties and necessities of medical practise and so was especially fitted to act as a sort of liaison officer between the two great wings of the medical army, the investigators who have the difficult task of discovering new truths, and the practitioners who must learn to apply these truths to the preservation of health and the protection from disease. No one in our generation, I venture to say, was more useful in this country in bringing about a helpful and sympathetic understanding between the laboratory worker and the physician. As a physiologist he enjoyed the best opportunities and training of his period. He was equipped with the methods and technique that the subject owes to the great masters of the latter half of the nineteenth century. The more modern methods of physics and chemistry which seem to be essential for the new generation of physiological workers he did not possess, but he did not let this deficiency discourage him nor diminish in any way his activity in research. He had the wisdom to understand that the armamentarium with which he was provided was adequate for the accomplishment of much important and necessary investigation. He was no faint-hearted seeker after truth. There never was a time, I fancy, in his active life when his mind was not full of problems that he wished to solve and which he intended to solve in part at least with the aid of his experimental methods.

Dr. Meltzer was elected to membership in the American Physiological Society at its first annual meeting held in Philadelphia in December, 1888. From that time until his death he was perhaps its most faithful member in attendance, in the presentation of papers and in participation in the discussions and social intercourse. Other less heroic spirits might weary under the load of papers and seek respite and fresh air by frequent disappearances between acts, but this was never the case with Meltzer. He loved the meetings, he loved to listen to the papers and to take part in the discussions. He had something to say of value on almost every paper that was read. It is small wonder therefore that his position and influence in the society constantly increased in importance. He served as president from 1911 to 1913, but the older members know that before that time and since his advice was paramount in matters of policy as well as in the selection of officers. He was sincerely and deeply interested in the welfare of the society and believed in its importance as one of the major agencies concerned in the advancement of the cause of physiological research. What he had to say in regard to its policies was always said in the opening meetings and in the plainest of terms, and if in his opinion it was necessary to be critical of either persons or things he never hesitated to express what was in his mind. His courage in stating his position in matters in which some personal criticism necessarily played a part in the discussion has often aroused my admiration. He did not indulge in circumlocutions or euphemisms, but was entirely frank and direct. There could be no mistake as to what he thought and yet no matter how plainly and bluntly he might speak there was as a rule no offense taken, because it was evident to every one that what concerned him was not personalities but the principles involved. The American Physiological Society owes much to him for the sound policies and wholesome traditions which have characterized its his-

tory. I have not so much direct knowledge of the influence exerted by Dr. Meltzer in the numerous other societies of which he was a member. In the case of the Society for Experimental Biology and Medicine we know that he was its chief founder and for many years its primum movens—it was long known familiarly among scientific men as the Meltzer Verein. I have no doubt that in every organization with which he was connected his influence was always exerted on the side of the highest scientific ideals—no other position was possible for him. He was high-minded, courageous, sincere and optimistic. Age oftentimes lays a stiffening hand upon the scientific worker, causing him to shrink from the laborious routine of research, but with Meltzer there was never any indication of weariness or sense of failure. In spite of much ill-health and physical suffering in his later years he was full of hope and energy and determination in the pursuit of his scientific ideals and problems. Death came to him, as he would have chosen, while in his study and at his work. He was a good and faithful servant in the cause of medical research. Rewards came to him in the form of academic honors and membership in the most important medical and scientific societies, but I am confident that he found his greatest recompense in the joy of the work and in the affectionate appreciation of his many scientific friends.

W. H. Howell

THE RELATIONS OF PSYCHOLOGY TO MEDICINE[1]

A sufficient excuse for this discussion of an old theme is the notable rapid progress of both psychology and medicine, and the consequent changes in their actual and prospective relations. Fresh consideration of the question what should be the relation of psychology to medicine may benefit alike the sciences and the art concerned. The discussion may not be exhaustive; instead, it must be limited to an outline of the theme and the indication of those characteristics of the two principal subjects which are preeminently important as conditions of profitable working relations.

Medicine as an art strives to maintain or restore the health of the human being. The object of the physician's concern, his patient, ordinarily is both active and conscious. It is therefore desirable that the practitioner be thoroughly grounded in the facts and principles of human action and experience. Although this may seem self-evident, it has not been accepted generally in medical education. The history of medicine indicates that it has long sought to attain a reliable and adequate scientific basis for the practise. Naturally enough, knowledge of structure was first of all sought, and in consequence, the science of gross anatomy developed. Subsequently it gave rise to histology, cytology, embryology, pathological anatomy, and bacteriology, all of which are now recognized as essential morphological bases for the art of medicine. Paralleling the growth of the knowledge of structure, although somewhat more recently and more slowly developed, are the various sciences which deal with organic functions. Among these, human physiology was first chronologically, and first in importance to medicine. For several centuries it has grown steadily, gradually extending its inquiries to most of the important types of organic process. From it have arisen a number of special sciences of function and its alteration, as, for example, in immunology, pathology, and certain aspects of pharmacology. But strangely enough, physiology has failed to take possession of those large and important groups of phenomena in human life which are designated by the terms behavior, conduct, experience, and mind.

[1] Address of retiring vice-president and chairman of Section I, American Association for the Advancement of Science, Chicago, 1920.

Viewed as functional aspects of human life, these phenomena appear to be wholly appropriate material for the science of physiology. That they have not been considered other than casually is doubtless due to the difficulty of devising methods for their exact study, and the historical relation of conduct and experience to philosophy and to the experimental psychology which emerged from it.

It seems entirely fitting to ask, in view of this limitation of the scope of physiology and the dependence of medicine upon thoroughgoing and intimate knowledge of life processes, does medicine need a science of human behavior and experience as one of its fundamental or basic disciplines? A generation ago this question would have been answered in the negative by the majority of physicians, possibly even by many of those who were most intimately responsible for the development of physiology. At present, the situation is radically different, because it has become clear that the science of psychology has developed important methods and assembled a body of facts whose theoretical and practical importance can not safely be ignored. Demonstrations of the practical applications of mental measurement, as for example in the army, in educational institutions, in industry, in penal institutions, and in hospitals, have attracted the attention of intelligent physicians, and have caused many of them to take an aggressive and constructive attitude with respect to the relation of psychology to medicine. They will unhesitatingly give an affirmative reply to the important question which has been formulated, and will earnestly support their position by pointing out the vital importance of knowledge of human action and human experience in every practical situation which confronts the practitioner. Some of them may go so far as to maintain that the average physician of to-day is quite as ignorant of the structure and functions of the human mind and of the activities through which experience gains expression, as were his predecessors of a thousand years ago of the structure and functions of the body. And they may further maintain that most physicians are entirely untrained in methods of observing and measuring human action and experience, and therefore unable to apply even the simple and well established procedures of practical mental measurement.

Assuming, then, that the medical profession recognizes its need of systematic knowledge of human behavior and experience and of the technique necessary to the acquirement and extension of such knowledge and its practical use, it is necessary to consider next whether psychology or any other existing discipline is prepared to meet this need, and if so, how it may best be done. This necessitates an examination of the status and meaning of psychology.

It is unfortunately true that many intelligent and highly educated persons, among whom are some physicians, are confused and misled by the diverse developments of psychology. This is chiefly because psychical research, spiritualism, certain kinds or fragments of philosophy, mental telepathy, isolated products of introspection, and various methods of studying behavior and conduct, each and all claim the name psychology. It is inevitable that this state of affairs should confuse the person who, unacquainted with the problems of behavior and experience and likewise unfamiliar with the methods of solving them, views the manifestations of psychology as an interested observer. It should be remarked, however, that the situation is not essentially different from that in medicine, for there the disinterested observer notes the existence of

numerous medical sects, each of which more or less insistently and ostentatiously claims for itself either a monopoly of what is useful in medical practise or the most fruitful of therapeutic methods. The layman, consequently, has grave doubts and misgivings about the trustworthiness of the art of medicine and the adequacy of its scientific basis, which are identical in principle with those entertained by the physician for psychology. It is therefore very much to the point to establish the fact that there exists a genuinely reliable, thoroughly scientific, and progressive science of behavior and experience, which rightly claims the name psychology, just as there is a reliable body of knowledge concerning human form, function, and disease, which is called medicine. The fact that the word "regular" must be used by a certain group of medical men to distinguish themselves from other medical sects should not be overlooked in this connection, for what is desirable or necessary in medicine happens to be equally so in psychology. It is also true that the broadminded, genuinely scientific psychologist is likely to be as much offended by the name telepathist, or spiritualist, as is the "regular" physician by the name eclectic, or osteopathist.

There are at least five principal phases or aspects of modern psychology which deserve mention although they have widely differing significance for medicine. They may be designated as philosophical psychology, psychical research, introspective psychology, genetic psychology, and behaviorism.

Philosophy, not many generations ago, included all of the disciplines which are now called natural sciences. Psychology has been slowest to emancipate itself, chiefly because its phenomena are most difficult to study by scientific methods. From certain points of view, philosophical psychology is quite as important as any other aspect of the subject, but for the present, at least, it need not especially concern medical education or medical practise, and least of all should it be permitted to obscure the development of psychology along lines similar to those followed by the other natural sciences.

Despite claims to the contrary, psychical research, and the spiritualistic developments of psychology, are too uncertain of their facts and either too uncritical or unreliable as to methods to be seriously considered in connection with practical problems. What may develop from or through them it would be rash to attempt to predict, but it is obviously safe to maintain that they do not constitute the science of psychology and lack immediately important significance for medicine.

The primary development of psychology and its center of reference is the psychology of the self. This is necessarily a product of introspection or self-observation. It is the aim of introspective psychology to discover the elements of experience, to formulate the laws of their combination, and to describe those complex phenomena which constitute mind. That much has been achieved in this direction must be evident to any intelligent person who reads attentively the works of leading introspective psychologists. Medicine can no more afford to neglect this important method of studying experience and its expressions than can education or any other art which works upon human material. But it is equally true that introspective psychology may not fairly or profitably be accepted as the whole of the science.

The term genetic psychology has been applied to the historical or developmental description of behavior and experience, which results from the application of the

method of comparison to the materials of observation. In this branch of psychology, the development of behavior and of mind in the individual and also in the race is studied by means of objective methods similar to those of physiology, and by the method of self-observation whenever it is applicable. Genetic psychology is even more intimately related to the medical sciences and their practical applications than is introspective psychology.

The name behaviorism has been applied to a recent development which, in effect, is a revolt against the introspective method. By the application of objective methods identical with or similar to those of physiology, it undertakes to discover and describe the various phenomena of mental life and to formulate their laws. In its extreme form, it is merely the extension of physiology to include all types and aspects of human activity and experience. It may be pointed out in this connection that the science of physiology has made few attempts to study forms of activity other than reflexes. Behaviorism would alter this situation by subjecting instinctive, habitual, and voluntary actions to scientific analysis and measurement.

It has been asserted that the general science of psychology is neither psychical research, on the one hand, nor its logical extreme behaviorism, on the other hand. Instead, like medicine, it is inclusive of what is valuable in the methods and reliable in the results of all of its branches, aspects, or special developments. For psychology in its medical relations, the term psychobiology is proposed. This term suggests the study of experience as biological phenomenon. In introspective psychology, in genetic psychology, and in behaviorism, there is much that should be valuable to medicine. Assuming that it comprehended the important scientific procedures and the established facts and principles of the several branches of psychology, psychobiology would constitute a natural bridge between physiology and psychiatry. On the one hand, it would appear as a mere extension of physiology to include human behavior and experience, and on the other hand, it would exhibit kinship to psychiatry in the utilization of the subjective or introspective method. Whether or not it be considered a distinct science, psychobiology would serve to link the basic functional science of physiology with neurology and psychiatry.

The history of medicine clearly enough indicates gradual emancipation from superstition and the slow achievement of that immense body of knowledge which renders medical treatment increasingly certain and safe. Throughout this history, mental disorders have been less intelligently, less scientifically, and less satisfactorily treated than have most others. One obvious reason for this condition of affairs is the lack in medical schools of any provision for the training of students in psychobiology. Medicine, by its passive attitude toward the development of this science, has permitted, if it has not also encouraged, the development of numerous one-sided and extreme sects whose avowed purpose is the cure of human ills by psychological means. There exist to-day several species of psychotherapy or psychological medicine, and, in addition, such religious movements as the Emmanuel Church Movement, which perhaps would not have developed and certainly would not have flourished so remarkably had medicine provided in its schools and hospitals for the development of psychobiology as it has for the development of physiology.

Granted that medicine needs psychobiology, and that the status of the science, although unsatisfactory in many respects, is

such as to justify its introduction in medical schools, what might immediately be undertaken? This question certainly should not be answered in the same way for all schools. Consequently the following possible lines of activity should be considered in their relations to local situations and special needs. Even though excellent general courses in psychology be available in colleges or other medical preparatory institutions, it may reasonably be maintained that psychobiology should be given a place, at least tentatively and experimentally, in progressive medical schools, for only in the midst of medical research, education, and practise, can psychobiological methods, knowledge, and laws, be rapidly and effectively developed to meet the needs of the physician.

The following activities are suggested as immediately practicable and desirable in the larger medical schools, provided always that a thoroughly competent biologically trained psychologist is available.

I. There could be presented, initially as a voluntary course, if it is not expedient to add a new subject to the curriculum, a lecture, demonstration, and laboratory course in psychobiology, which should acquaint medical students with the principal facts and laws of human behavior and experience and with the more important methods of observing and measuring these phenomena.

II. A groundwork in psychobiology having been prepared by the general course, opportunity should be afforded interested students for more intensive training in the use of psychobiological methods. This should provide alike for training in the methods of practical measurement and for psychobiological research. In connection with the latter, investigation might be undertaken of problems formulated in the lecture course in connection with such topics as the analysis of instinctive activities; the development, modification, and integration of habits; the nature and significance of ideational types; the discovery of peculiarities or defects of behavior and experience. Similarly in connection with practical psychobiological measurement, the medical student might be given opportunity to utilize or develop methods of measuring aspects of behavior and experience in relation to diagnosis and treatment. Important types of practical psychological tests might also be exhibited in their relations to medical aspects of hygienic, industrial, and educational problems.

III. As an extension of psychobiology toward psychiatry, special lectures and laboratory exercises dealing with atypical, abnormal, or pathological behavior and experience could be provided. These might ultimately be expected to develop into a systematic course in psychopathology, which should be carefully correlated with the established medical instruction in neurology and psychiatry. In this same connection, as a method of supplementing such practical and research activities as are referred to in the preceding paragraph, psychobiological methods might be placed at the service of the neurological and psychiatric clinics, for psychology has already developed a considerable array of methods whose diagnostic value in neuropsychiatric practise has been definitely established.

IV. Another important field of service for psychobiology is preventive medicine and hygiene. Here, research in connection with the characteristics and variations of behavior and experience which are significant of undesirable or dangerous nervous or mental tendencies is particularly in point, although didactic lectures might also be offered to advantage. Thus psychobiology might be utilized increasingly as

the partial scientific basis of mental hygiene.

It is the conviction of the writer that urgent need exists for pioneering in psychobiology as a basic medical science. It has already been suggested that this pioneering should be done in a medical environment, for by taking the matter into its own hands the medical faculty should be able to secure, more quickly and satisfactorily than otherwise, those developments and applications of psychobiology which are clearly desirable. It will not suffice to meet the general needs of medicine, if psychopathology instead of, rather than in addition to, the more inclusive discipline psychobiology, is established in leading medical schools. For it is quite as improbable that the medical student will acquire adequate training in psychobiology during his premedical years as that he will acquire similarly adequate training in physiology or in anatomy.

There are three important possibilities with respect to the administrative relations of psychobiology in medical schools. The subject may be treated as a part of physiology, it may be established independently, or it may be associated with neurology and psychiatry. For the sake of its development as a fundamental discipline, it would appear preferable to have it either associated with physiology or given an independent status during the experimental stage of its development in a medical environment. To place it with physiology would tend to lessen administrative problems and to simplify the organization of instruction and arrangements for research, but, on the other hand, it should be recognized that the clinical relations of psychobiology are likely to be much more numerous and compelling than those of physiology and to make it more and more truly the connecting link between physiology and psychiatry. For the former subject, it must always appear as a logical extension of its field of interest; for the latter, as an essential part of its scientific basis.

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SCIENTIFIC EVENTS

MEDICAL EDUCATION IN CHINA[1]

Recent reports state that in all China there are found to be less than 2,000 physicians. What a small proportion of the population of 400,000,000 Chinese people can receive scientific treatment in case of illness or injury! In an effort to ascertain the exact number of students looking toward medicine, if not also to stimulate the youth of China to look toward the practise of medicine, a survey has recently been made of the middle schools of China. In 153 of the institutions reporting, there are 36,095 students, and of these 1,153 stated that they were planning to study medicine. Since this is only about 20 per cent. of all middle schools, the total number who may enter on the study of medicine will be considerably larger.

The Rockefeller Foundation is said to have abandoned its purpose of erecting at Shanghai a great medical school similar to the Union Medical College at Peking. This decision is said to be due to the fact that in its initial session the college had a class of only seven students, although $6,000,000 had been expended for its construction and maintenance. This small attendance is said to be due to the fact that the medical course is given in the English language and that only a small number of the universities and schools in the neighborhood of Peking emphasize their courses in English. The situation is said to be quite different at Shanghai, where English is more generally taught, which will insure larger numbers of Chinese medical students.

In order to provide a clear field when a large

[1] From the *Journal* of the American Medical Association.

medical school in Shanghai was planned by the foundation, the Harvard Medical School of China was purchased by the Chinese Medical Board, and the Pennsylvania Medical School at Shanghai consented to step aside in favor of the larger institution. A few months ago, however, after the foundation withdrew from the field, the Pennsylvania Medical School began pushing forward its plans to enlarge its plant. The erection of a science laboratory building, to cost $100,000, was promptly begun. This will house departments of physics, chemistry and biology and, temporarily, the medical laboratories also, but the latter will be removed to other buildings which will be erected later. The institution will provide a premedical course covering three years, and a medical course of four years similar to those established by the Peking Union Medical College.

THE FOREST SERVICE

According to the annual report of Chief Forester W. B. Greeley, the receipts of the National Forests have increased 93 per cent. from 1915 to 1920, while the total appropriations for the Forest Service, exclusive of deficiency fire-fighting funds, has increased only 8 per cent. The receipts for 1920 were 10 per cent. greater than for 1919, and an equal increase for the current fiscal year may be expected, unless too much new business has to be rejected on account of lack of funds and trained employees. The appropriations for the current fiscal year were increased only 3 per cent.

In addition to the actual revenue, according to the report, there is an enormous return to the public through the protection of the 500,000,000,000-odd feet of timber for future use, the protection of the headwaters of innumerable feeders of navigation, irrigation and hydroelectric power and the recreational facilities made available to hundreds of thousands of people. "There will always be national resources not measurable in dollars which in public benefit exceed the receipts paid into the Treasury," the report says.

The purchases aggregated at the close of the fiscal year 1,420,208 acres in the White Mountains and the Southern Appalachians and 12,094 acres in the Ozark Mountains of Arkansas. The original program of acquisition contemplated the purchase of about 1,000,000 acres in the White Mountains and not less than 5,0000,000 acres in the Southern Appalachians. Nearly one half the proposed White Mountain area has been acquired, but slower progress has been made in the southern areas.

Further appropriations to carry on the purchase work within the areas have been recommended by the National Forest Reservation Commission. "To leave these Eastern forests in their present half finished condition would subject them to formidable fire hazards and other difficulties of management."

There is need also for some action to reduce the danger to the National Forests from the 24,267,723 acres of private lands that are intermingled with land belonging to the government. Most of this land is forested and its misuse, mismanagement and neglect jeopardize the government's holdings. General legislation is urged to acquire the private land by purchase or exchange.

The 1919 fire season was unusually severe and long drawn out, the report states. It was the third successive year of severe drought in the northwest, and the worst of the three. Fires began to occur before much of the customary work of preparation had been done, and this imposed a further handicap upon the forest force, which had been depleted by the loss of many experienced men. The total number of forest fires in the National Forests was 6,800, or 1,227 greater than in the previous year. The area of National Forest lands burned over was 2,000,034 acres, the estimated damage was $4,919,769, and the total cost of fire fighting was $3,039,615.

GYPSUM FELLOWSHIPS

At the recent annual meeting of the Gypsum Industries Association, they provided for six to eight fellowships, each bearing a stipend of $1,000 to $1,500 a year, depending on the training and ability of the holder.

These fellowships are to be located at various agricultural colleges in the eastern part of the United States for the purpose of investigating the use of gypsum in crop production and for making a fundamental study of the relation of sulphur to crop nutrition and growth.

The revival of interest in gypsum and other sulphur fertilizers has largely grown out of the remarkable results that agricultural scientists and farmers of Oregon and Washington are obtaining from the use of sulphur sources on alfalfa and clover, and other legumes. In many of the soils of these states a leguminous crop can not be successfully grown without an addition of a sulphur source, and such additions give increases in yield ranging from 25 to 500 per cent.

Two of these are to be used in continuing the fellowships that have already been in operation for considerably more than a year at the University of Chicago and at Iowa State College. The others will be strategically distributed at state agricultural colleges and experiment stations in central and eastern United States.

THE NATIONAL MUSEUM AND DR. JORDAN

ON the occasion of the seventieth birthday of David Starr Jordan, chancellor emeritus of Stanford University, which occurred on January 19, the following letter was addressed to him by Dr. Charles D. Walcott, secretary of the Smithsonian Institution:

On the occasion of your seventieth birthday, permit me, on behalf of the Smithsonian Institution and the National Museum, to offer my congratulations as well as thanks for your faithful cooperation during half a century.

For fully fifty years you have labored for the high ideals expressed by the founder of this institution in the words "increase and diffusion of knowledge among men," and for nearly the same period your work has been in close association with the institution and its staff.

Your work has also been intimately connected with the National Museum since its organization as such, and your scientific papers are among the most valued contributions to the museum's publications from its very first volume to the latest. Your early associations were with Baird, Gill, Brown, Goode and Tarleton Bean, and your name will go down in the museum's history linked with theirs. No wonder we have always regarded you as one of us, and we know that this sentiment is being reciprocated by you.

As a slight token of my appreciation of your services to science and to the museum, may I not ask you to accept the designation as honorary associate in zoology?

I trust that you may be spared for many more years to continue your work.

SCIENTIFIC NOTES AND NEWS

WILLIAM THOMPSON SEDGWICK, professor of biology in the Massachusetts Institute of Technology since 1883, died on January 25, aged sixty-five years.

AT a meeting of the Société belge de Médecine of Brussels, Belgium, held on December 27, 1920, Dr. William H. Welch, director of the school of hygiene and public health of the Johns Hopkins University, and Dr. Simon Flexner, the director of the Rockefeller Institute for Medical Research, were made honorary members of that organization.

THE dinner and reception given by the medical profession of Philadelphia to Dr. William W. Keen, at the Bellevue Stratford Hotel, on January 20, in honor of his eighty-fourth birthday, was attended by 600 physicians and friends. Dr. George de Schweinitz was the toastmaster, and the speakers included Dr. William H. Welch, Baltimore; Dr. J. Chalmers DaCosta, Philadelphia, and Mr. David Jayne Hill. Major-General Merritte W. Ireland, surgeon-general, U. S. Army, presented a specially bound volume containing addresses and letters as a tribute to Dr. Keen, and Dr. William J. Taylor, of the College of Physicians, presented a life size bust of Dr. Keen in army uniform, by Samuel Murray. Dr. Keen in responding made an address that will be printed in SCIENCE.

A PORTRAIT of Dr. Samuel W. Lambert, dean emeritus of the college of physicians and surgeons, Columbia University, was presented to the college on January 28. The presentation

was made by Dr. George S. Huntington, professor of anatomy.

The John Fritz gold medal for notable scientific and industrial achievement has been awarded to Sir Robert Hadfield, inventor of manganese steel and leader of the British steel industry. The award of the medal has been authorized unanimously by the sixteen members of the committee representing the national organizations of civil, mechanical, mining, metallurgical and electrical engineers. The medal was established in 1902 in honor of John Fritz, iron-master of Bethlehem, Pa.

The Honor Society of Agriculture, Gamma Sigma Delta, with chapters in the University of Minnesota, University of Nebraska, University of Missouri, Iowa State College, Oregon Agricultural College, Kansas State College, State College of Utah and Alabama Polytechnic Institute conferred honorary membership for distinguished services to agriculture on Dr. Eugene Davenport, of the University of Illinois; Dr. T. B. Osborn, of Yale University; Dr. H. P. Parmsby, of State College, Pennsylvania, and Dr. L. H. Bailey, of Ithaca, N. Y. The medal was conferred upon Dr. Davenport.

The twenty-fifth anniversary of the publication of the discovery of the roentgen ray by Professor Roentgen has been celebrated with tributes to Roentgen in Germany. He retired last spring from the chair of experimental physics at the University of Munich.

Dr. E. O. Teale has been appointed government geologist of Tanganyika Colony, formerly German East Africa.

Professor E. B. Mathews, of the Johns Hopkins University, has been appointed chairman of the advisory council of the United States Board of Surveys and Maps.

The $5,000 prize offered by Mr. Higgins through the *Scientific American* for the best popular essay on the Einstein theories was awarded to the essay submitted by Mr. L. Bolton, of London. It appears in the *Scientific American* for February 5, and will be followed in subsequent issues by a number of the other essays, some in full and others in part.

Officers of the American Anthropological Association have been elected as follows: W. C. Farabee, of the University of Pennsylvania, president; A. V. Kidder, of Phillips Andover Academy, secretary; J. R. Swanton, of the Bureau of Ethnology, treasurer and editor.

The Missouri Society for Mental Hygiene was organized in St. Louis on January 13, with the following officers: Dr. M. A. Bliss, *president;* Dr. J. F. McFadden, *secretary;* Dr. J. E. W. Wallin, *treasurer.*

The American Journal of Psychology, established by Dr. G. Stanley Hall in 1887, and since edited by him, has been acquired by members of the department of psychology of Cornell University, and will hereafter be edited by Professor E. B. Titchener.

The Rockefeller Foundation announces the election of Miss Norma Foster Stoughton, to become assistant secretary of the Rockefeller Foundation, and Miss Margery K. Eggleston, to become assistant secretary of the China Medical Board, a department of the foundation. Miss Stoughton entered the staff of the Rockefeller Foundation in 1916 and has made a special study of hospital administration and service. Miss Eggleston has been since 1914 with the General Education Board, the China Medical Board and the Rockefeller Foundation. In addition to her position with the China Medical Board she has just been appointed assistant secretary of the trustees of the Peking Union Medical College, an institution erected and maintained in Peking by funds of the Rockefeller Foundation.

Dr. William W. Cort, associate professor of helminthology in the school of hygiene and public health of Johns Hopkins University, has been appointed director of the expedition recently formed by the International Health Board of the Rockefeller Foundation, New York, to study the hookworm larvæ in Trinidad, West Indies. The expedition will leave for Trinidad about May 1 and will be gone four months. Dr. Cort will be assisted by Dr.

J. E. Ackert, professor of parasitology of the Kansas State Agricultural College, and by Dr. D. L. Augustine, assistant in medical zoology at the Johns Hopkins University.

Dr. Ludwig Silberstein, of the research laboratory of the Eastman Kodak Company, delivered a series of fifteen lectures before the faculty and students of the University of Toronto on January 10–22. The first six lectures were devoted to explaining the general procedure of fixing events in space and time, and to developing the presence of special relativity with their consequences and applications to optics and to dynamics of a particle. The next six lectures were devoted to the conceptual as well as the mathematical aspects of general relativity and gravitation theory. The last three lectures were concerning the quantum theory of spectra.

At the meeting of the American Philosophical Society on Friday evening, February 4, Dr. John C. Merriam, president of the Carnegie Institution of Washington, read a paper entitled "Researches on the antiquity of man in California."

The Aldred lecture was delivered at the Royal Society of Arts on January 12, by Dr. C. S. Myers, director of the psychological laboratory, and lecturer in experimental psychology, University of Cambridge. The subject was "Industrial Fatigue."

The American Roentgen Ray Society will award $1,000 to the American author of the best original research in the field of the roentgen ray, radium or radio-activity.

Mary Watson Whitney, professor of astronomy emeritus and from 1889 to 1910 director of the observatory of Vassar College, died on January 20 aged seventy-three years.

Dr. Lincoln Ware Riddle, assistant professor of cryptogamic botany and associate curator of the Farlow Herbarium of Cryptogamic botany, died at his home in Cambridge on January 16 in the forty-first year of his age.

Prince Peter Alexeievitch Krapotkin, distinguished as a geographer and for his books on science and natural history, has died at Moscow at the age of seventy-eight years.

M. Painlevé, professor of mathematics at Paris and former prime minister has returned from China to which he had been sent on a mission concerning Chinese universities and railways. He has obtained from the Chinese government the promise of an annual subvention of 100,000f. for an institute of Chinese higher studies in Paris. The Chinese government has also agreed to the creation, in one of the Chinese universities, of an affiliated branch of the University of Paris, and it will devote to this purpose the sum of 500,000f. annually, on condition that the French government gives the same amount. The Chinese president has further promised to have reproduced the collection of four great classics which contain the essence of Chinese civilization, and to present three copies to France. These volumes run to not less than 5,000,000 pages.

The *British Medical Journal* states that the late Dr. A. J. Chalmers, the authority on tropical diseases, who died on his way home on leave in April last, left a valuable collection of medical books mainly on tropical diseases, and including some almost priceless incunabula. The whole of these, with the exception of about sixty volumes, presented to the Royal College of Physicians of London, have been given by Mrs. Chalmers to the Royal Society of Medicine, which has decided that the collection shall be kept together and be known as the "Chalmers Collection." Mrs. Chlamers has presented the society with the sum of £500 for the shelving and furnishing of a room in which the books will be kept as a memorial of her husband. It is hoped that the collection of books on tropical medicine will be added to from time to time, and the room chosen for the Chalmers Library is well adapted for the purpose. This coincides with the reconstruction of the new Section of Tropical Medicine and Parasitology. The section was formed in 1912, but was suspended during the war, and has only this session been formerly constituted. The new section will start with a library of its own—perhaps the finest collection of books on tropical medicine to be found anywhere.

The third half-yearly report on the progress of civil aviation in England has been issued as a White Paper. According to the abstract in *Nature* it is pointed out that regular air services have now been established from London to Paris, Brussels and Amsterdam, and that passenger, mail and goods traffic is increasing. The total number of aeroplane miles flown in the half-year ending September 30, 1920, is nearly 700,000, whilst the aggregate since May, 1919, exceeds 1,000,000. The number of passengers by air exceeds 30,000, whilst the goods carried weigh little less than 90 tons. In value the imported goods exceed £500,000, whilst the exports and re-exports are about half that amount. As part of the mail services, about 50,000 letters have passed each way between London-Paris, Brussels and Amsterdam with a regularity which is notable. Of the three routes the best shows 94 per cent. of deliveries within three hours of schedule time, and the worst 76 per cent. As part of the organization for further improving these records, it is stated that the wireless direction-finding apparatus installed at Croydon has proved its value, enabling aircraft to correct their course in thick weather. The equipment of aircraft with apparatus for wireless telephony is extending, as it is found to be of considerable assistance to navigation. The fatal accidents are given as in the ratio of 1 per 50,000 miles flown or per 5,000 passengers carried. The international character of flying is brought out in a statement of activities in other countries.

UNIVERSITY AND EDUCATIONAL NEWS

Following the investigations made by Professor S. C. Prescott, instructor in industrial biology of the department of biology and public health of the Institute of Technology, who has just returned from Seattle, where he studied the work of the College of Fisheries of the University of Washington, it has been announced that the administrative committee of the institute is considering the inclusion of a course in the scientific problems of fish culture and problems of the fisheries. Establishment of a college of fisheries similar to that of the University of Washington has also been suggested to Harvard University, by leading men in the fishing industry at Boston.

Heretofore Brazil has had no regularly coordinated university though she has had individual faculties vested with the power to confer degrees. The faculties of law and medicine and the polytechnic institute of Rio de Janeiro have now been combined and will be known henceforth as the University of Rio de Janeiro.

Dr. John M. Thomas, since 1908 president of Middlebury College, has accepted the presidency of the Pennsylvania State College.

Dr. E. K. Marshall, professor of pharmacology in Washington University, has been elected professor of physiology in the Johns Hopkins Medical School, beginning in July. Dr. Marshall received his bachelor's degree from Charleston College, 1908, and the doctorate in philosophy and medicine from the Johns Hopkins University.

At Yale University the following lecturers in special applications of organic chemistry in the industries have been appointed: Dr. Ralph H. McKee, professor of chemical engineering, Columbia University; Dr. Moses L. Crossley, research chemist, Calco Chemical Co.; Dr. P. A. Levene, biochemist, Rockefeller Institute for Medical Research; Dr. David Wesson, technical manager, The Southern Cotton Oil Co.; Dr. Harry N. Holmes, professor of chemistry, Oberlin College, and Dr. Elmer V. McCollum, professor of chemistry, School of Hygiene, Johns Hopkins University.

DISCUSSION AND CORRESPONDENCE

ASTRONOMICAL RESEARCH IN THE SOUTHEASTERN STATES

To the Editor of Science: In Science, December 10, 1920, page 545, I commented upon the interesting fact that the observatory of the University of Virginia, named after the donor, Mr. McCormick of Chicago, is the only active observatory in our southeastern states. My further comment that Barnard and other astronomical enthusiasts, born and grown to manhood in the former slave-holding states, had found their opportunities in the great

northern observatories, was incorrect and unjust, in that it overlooked the case of Dr. C. P. Olivier, for several years an astronomer in the McCormick Observatory. I regret exceedingly this oversight, and I am at a loss to explain it, especially as Dr. Olivier was for a year a member of the staff of the Lick Observatory, and his valued astronomical contributions are thoroughly familiar to me. It is my duty and pleasure to say that the observatory of the University of Virginia, thanks in good measure to the abilities and enthusiasms of Director Mitchell and astronomer Olivier, is as efficient in good works as any existing observatory. It is greatly to be regretted that their financial resources are so limited.

I should like to say that my comments upon the astronomical situation in the southeastern states were primarily not intended to be taken in the negative sense. There was with me the hope that a public expression on the subject might lead to a better realization of existing needs, and to more adequate financial provision in the positive sense.

W. W. Campbell

TECHNICAL STUDY AT OBERLIN COLLEGE

In Science for December 31 I find a note:

> It is planned to establish a technical school at Oberlin College with accommodation for about seven hundred students.

This statement is not quite correct. President King has several times proposed, upon his own responsibility and doubtless merely for informal consideration, a plan for technical departments chiefly in chemical engineering and metallurgy. I believe the proposal has not yet come to the faculty for formal consideration, so of course does not have their endorsement. As all matters of internal policy and administration in Oberlin are controlled by the faculty, in accordance with an old vote of the trustees twice recently reaffirmed and now in part of the nature of a contract, it is evident the proposal has not yet taken the first formal step toward adoption. President King, who is one of the staunchest supporters of this Oberlin system, apparently thinks that it is not yet time for formal consideration of the plan. It has been mooted for two years, and indeed over fifteen years ago something of the sort was suggested, but it has received only individual consideration by members of the faculty. Judging from numerous conversations, I think the faculty, if they are asked to consider it, will decide the plan to be unwise. A general feeling among the faculty is that Oberlin's effort should be centered upon strengthening herself in every way as a college before entering upon university or technical school work.

Maynard M. Metcalf

FURTHER REMARKS ON "THE USE OF THE TERM FOSSIL"

The short article entitled "The Use of the Term Fossil" published in No. 1330 of Science seems to have fulfilled the writer's object of stimulating discussion. The first criticism, by Garret P. Serviss, appeared in the *Sunday American*[1] and while approving "poetic license" the author continues the plea for a more careful use of scientific terms by the scientist, as follows:

> Half the fogs that trouble the ordinary reader when he undertakes to traverse the fields of science are due to the capricious use of words which ought to have an invariable signification.

In No. 1348 of Science, under the title "Professor Field's Use of the Term Fossil," Professor Authur M. Miller suggests the following definition: "Any trace of an *organism* that lived in a past Geological Age." He then states that such expressions as "fossil suncracks" and "fossil flood plains" are "illuminating" and "apt" and "are valued contributions to geological phraseology." In a recent contribution by a well-known paleobotanist, we find the term "fossil climate." Would it be considered "illuminating" or "apt" to define paleoclimatology as the study of "fossil climates"? There is a science of words as well as of things, and is it not true that much of the

[1] July 22, 1920.

misunderstanding in biological discussions arises from the misuse of such terms as *mutation* and *saltation?* We would not quibble with Archbishop Trench's remark that words simply will not stay tied as regards their meaning but are "constantly drifting from their moorings," but the more the scientist allows his vocabulary to drift the more is he disturbed by the redefined or original terms of his colleagues who, believeing it impossible to use words of two, three or more meanings, continue to inflict long-suffering humanity with an ever-increasing nomenclature. Rather do we agree with Alice who, after listening to a dissertation by Humpty Dumpty in which he makes his words mean what he chooses them to mean—"neither more nor less," comes to the conclusion that his remarks are not particularly illuminating. Of course Humpty Dumpty was, among other things, a poet, not a geologist!

But Professor Miller also states that

> The definition proposed by . . . Field . . . is faulty in that it errs in the time concept. He has committed the popular error of considering historic synonymous with the present geological epoch.

This is an unfortunate misstatement by Professor Miller and it is only necessary to quote from the original text to show that Field was not making the "popular error" implied.

> A fossil is an object which indicates former existence of an organism which has been buried and preserved previous to historic time. According to this definition the mastodon preserved in the arctic ice is a fossil; the leaf buried in the gutter is not.

It is also worth noting that Schuchert and others distinguish the recent or *historic* period as beginning the Psychozoic era. If in agreeing with this concept an error has been committed, it is certainly not a "popular" one.

Paleontology, the study of ancient life, is literally the study of fossils. *Paleo* is accepted in earth science as meaning geologically ancient. As a last analysis, which is the more "apt," paleo climates or "fossil climates"?

Professor Miller's constructive criticism consists of the new definition already quoted. It has the advantage of being brief, but in using the expression "past geological age" (subdivision of the present geological epoch, *i.e.*, Bronze Age) he appears to make a very slight geological time distinction indeed. After careful reading of the whole text, we are under the impression that he means "past geological epoch" or *pre-historic!*

Richard M. Field
Department of Geology,
Brown University

THE BIOGRAPHICAL DIRECTORY OF AMERICAN MEN OF SCIENCE

The third edition of the Biographical Directory is now in type; it will be published as soon as the printers can complete their part of the work. The editor ventures to ask for the return of all proofs and also for information in case proof has not been received. A second copy of the proof (by letter post and with return letter postage) has been sent to those who did not return the first copy within a reasonable time. If it is not known that a scientific man can be reached at the address given, or even that he is living, it will in most cases be undesirable to include the biographical sketch.

It is gratifying that the number of those engaged in scientific work in America has increased from about 4,000 in 1905 to about 10,000 at the present time. This circumstance, however, has greatly enhanced the labor and the cost involved in the preparation of the work, and it is not possible to write individual letters of enquiry in all cases where this might be desirable. The editor consequently makes public this request for the return of the corrected proofs of all biographical sketches.

J. McKeen Cattell
Garrison-on-Hudson, N. Y.

QUOTATIONS

WHEN AN INVENTION IS NOT AN INVENTION

There exists in our patent and copyright laws a gap which has always seemed to us a

lamentable one, and one which there is not the slightest justification for leaving unfilled. This has to do with the invention—we use the word though the law denies its propriety—of printed forms for the keeping of accounts or any other purpose.

It goes without saying that much skill and thought may be expended upon the formulation of a set of forms which shall be the last word in furnishing a framework for the proper recording of a certain kind of data. Business of many kinds is dependent upon tabular devices of this sort under one head or another; the invention of such a form may be of great value to its users. It would seem that the man who devotes his time and energy and ingenuity to getting up a thing of the sort ought to be rewarded to the same degree and in the same manner as the man who invents a new safety pin or a novel design for a perfumery bottle or a clever trade-mark. But under the law and the decisions as they now stand he is able to get no protection of any description; you or I or anybody else may manufacture and sell his form in direct competition with him and he has no redress save to undersell us.

The hitch lies in the fact that the law defining invention is so worded that a blank form to be filled in by the user is not an invention. It has no mechanical features, and it is not a process or a product. If the inventor be sufficiently ingenious to design it in such fashion that the user has to punch a hole as part of the process of using it, or join two parts of it in a certain predetermined relationship, or fold the left fifth over upon the right fifth and tear them half off and turn one of them over again in order to bring into juxtaposition two parts of the paper that were originally remote, this constitutes the mechanical feature necessary to make the form stand up under fire as an "invention" entitled to patent protection. But in the absence of such a feature the patent examiners will have nothing to do with it; and if the unhappy inventor turns to the copyright division, he learns that whether his device is an invention or not, it certainly is no publication and he can not protect it by copyright. Even the feeble solace of a design patent seems denied him.

The situation has long been familiar to us. We are inspired to comment on it by a subscriber who shows us a farmers' account book which he has devised. This is an admirable article, and at the same time it fills a want; for the farmer, never an accountant, is required to keep accounts under penalty of paying an income tax on a lot of income that isn't income. But our subscriber can't advertise his little book decently, for if he does some substitute that doesn't have to meet any advertising expense will appear and wipe out his market. We think he has a grievance against the government that tells him that an invention is sometimes an invention and sometimes isn't.—*Scientific American.*

SCIENTIFIC BOOKS

"*The Airplane.*" By Frederick Bedell, Cornell University. D. Van Nostrand Co. Pp. 257.

The theory of flight has more than kept pace with the development of the airplane. It is possible, on the basis of constants determined in wind tunnels, to predict very closely the performance of an existing airplane or to design a plane for some desired performance. The fundamentals of this theory of flight are embodied in a number of recent treatises and are readily available to the student. In Bedell's work they are not only available but are presented in so attractive and understandable a form as to compel the interest of the reader. The present reviewer has read the book through twice, for the pleasure of following so masterly a presentation. Everything is reduced to its simplest terms; every idea is driven home; the influence of each element is illustrated by a series of graphs; the whole subject seems to develop itself. It is a book for the amateur, but it is also the best of beginning books for the serious student. And it explains so convincingly many things which are troublesome to the beginner, as for example, why can not speed be increased in level flight

merely by opening the throttle, as in the case of an automobile.

Professor Bedell's book shows an unusual gift for clean cut analysis and exposition; there are but few scientific or technical books that demonstrate these qualities in so high a degree.

The book does not attempt to extend the science of aeronautics. It is devoted primarily to a discussion of the problem of sustentation; the matter of stability is also treated, but in a qualitative way. It falls in a category between the popular book, superficial and inadequate, and the treatise, involved, and complicated. It is a book destined for a long and useful life.

LIONEL S. MARKS
HARVARD UNIVERSITY

SPECIAL ARTICLES

A FURTHER NOTE ON WAR AND POPULATION[1]

In a note published last summer[2] I drew attention to the course of the ratio

$$\frac{100 \text{ Deaths}}{\text{Births}}$$

in the principal belligerent countries of Europe between 1913 and 1918. All of the curves presented, with the single exception of that for Prussia, ended on a high point in 1918. The question was raised as to what would be their course after that year, and it was shown that England and Wales gave a value of 73 per cent. for 1919 against 92 per cent. for the high point in 1918. The first three quarters of the year 1920 give for England and Wales a value of 46.8 per cent. This is 10 points *lower* than the figure for 1913! For every death England had more than two births.

The *Journal Officiel* has recently published the 1919 figures for France (77 non-invaded departments only) to the following effect:

$$\frac{100\ D}{B} = \frac{63569400}{413379} = 154 \text{ per cent.}$$

This figure compares (for the same territory) with 198 in 1918, 179 in 1917, 193 in 1916, 169 in 1915, 110 in 1914, and 97 in 1913. In other words, in the next year immediately following the cessation of hostilities France's death-birth ratio came back to less than that of 1915, the first whole year of the war. With an increase of 157 per cent. in marriages in 1919 over 1918 there seems little risk in predicting that 1920 will show a ratio not far from 100, which will be about the normal prewar status, France having had for some time a nearly stationary population. The 1920 vital index for France may well prove to be considerably below 100.

Another, and even more striking illustration of the exceedingly transitory effect of war upon the rate of population growth, is seen in the figures for the City of Vienna. Probably no large city suffered so severely from the war as did this capital. Yet observe what has happened, as set forth in Table I. To this table I have added, for the sake of rounding out the data of this and the former paper, the death-birth ratios of the United States Registration Area for as many years as they are available, and for England and Wales, 1912 to 1920 (first three quarters of latter year).

TABLE I

Percentage of Deaths to Births

Year	City of Vienna	U. S. Birth Registration Area	England and Wales
1912	80	—	56
1913	85	—	57
1914	86	—	59
1915	113	56	69
1916	143	59	65
1917	195	57	75
1918	229	73	92
1919	162	58	73
1920	—	—	47[3]

These figures are shown graphically in Figure 1.

We note that:

1. The high point of the Vienna curve in 1918, 229 per cent., is higher than that for France (198 per cent.), and probably higher than for any other equally large aggregate of population in the world.

[1] Papers from the Department of Biometry and Vital Statistics, school of hygiene and public health, Johns Hopkins University, No. 27.

[2] Pearl, R., SCIENCE, N. S., Vol. LI., pp. 553–596, 1920.

[3] First three quarters of year only.

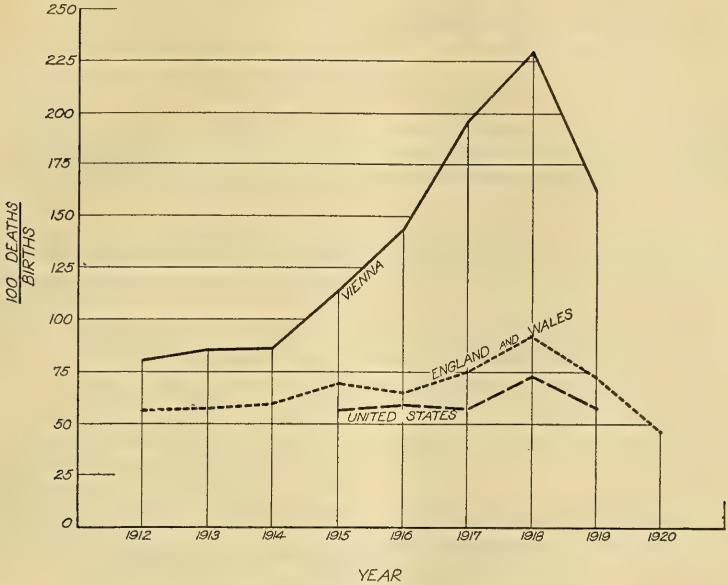

FIG. 1. Showing the change in percentage which deaths were of births in each of the years 1912 to 1919 for Vienna (———); 1915 to 1919 for the United States (— —); and 1912 to 1920 for England and Wales (- - - -).

2. The drop in 1919 is sharp in its angle and marked in its amount, the percentage coming down nearly to the 1916 figure—and this in spite of the very distressing conditions which prevailed in Vienna throughout 1919. It is not at all improbable, indeed rather it is probable that Vienna will in 1920 show a ratio under 100—that is, more births than deaths. If this happens she will have begun absolute natural increase again in only the second year after the cessation of hostilities, during the last year of which she had 2¼ persons die for every one born.

3. The war produced no effect upon the death-birth ratio in this country, as would have been expected. The influenza epidemic in 1918 raised the curve a little, but it promptly dropped back to normal in 1919.

4. In England and Wales the provisional figure indicates that 1920 will show a lower vital index than that country has had for many years.

Altogether, these examples, which include the effects of the most destructive war known to modern man, and the most devastating epidemic since the Middle Ages, furnish a substantial demonstration of the fact that population growth is a highly self-regulated biological phenomenon. Those persons who see in war and pestilence any absolute solution of the world problem of population, as postulated by Malthus, are optimists indeed. As a matter of fact, all history definitely tells us, and recent history fairly shouts in its emphasis, that such events make the merest ephemeral flicker in the steady onward march of population growth.

RAYMOND PEARL

THE WASHINGTON CONFERENCE ON THE HISTORY OF SCIENCE

The conference upon the History of Science, initiated by the American Historical Association at its annual meeting a year ago in Cleveland, proved such a success that the program committee devoted another session to the subject this December at Washington. Simultaneously the History of Science Section, which has recently been formed under the auspices of the American Association for the Advancement of Science, was meeting in Chicago, thus demonstrating the widespread interest in this promising field. This widespread interest was further evidenced at Washington by the variety of learned occupations represented by the speakers who included, in addition to professors of science and history, a librarian, a college president, and the head of an institution for research.

Robert S. Woodward, president of the Carnegie Institution of Washington, presided as almost his last official act before retiring from his long tenure of that office. In his introductory remarks he welcomed the attitude of the American Historical Association towards the history of science, emphasized the need of breaking down the artificial barriers which divide learning into different departments, and recalled a scheme dating back to 1907 but never executed for a general history of the inductive sciences by a number of collaborators under the direction of the Carnegie Institution.

In a paper on "Recent Realignments in the History of Medieval Medicine and Science," Dr. Fielding H Garrison, librarian, Surgeon General's Office, warned against past exaggeration of medieval ecclesiastical hostility towards science, and against deriding the science of that period. In British libraries alone Mrs. Singer has found 30,000 scientific manuscripts from the medieval period, of which some 15,000 are medical. Dr. Garrison went on to compare the general character of medieval science and medicine with that of other periods including our own, and to appraise its relations to them. The rapid progress of scientific discovery in more recent times was convincingly illustrated by a paper on "Developments in Electro-Magnetism during the Past Hundred Years," by Professor Arthur E. Kennelly, of Harvard University, who traced the achievements of Ampère, Farraday, and others, and showed the far-reaching influence and enormous importance of developments in electromagnetics in well-nigh every other field whether of scientific theory or of applied science and practical invention: as, for example, the effect of the theory of electrons upon chemistry and the earlier atomic theory.

Professor James Harvey Robinson, of the New School for Social Research, discussed with characteristic satirical wit and literary force to the delight of the large audience "Free Thought, Yesterday and To-day," from the standpoint of the student of intellectual history, comparing more especially the ways of thinking of the Deists and other eighteenth century philosophers with our own, and bringing out how the rules and methods of "the intellectual game" had profited by the scientific advance of the last century.

Because of the lateness of the hour Lyon G. Tyler, president emeritus of the College of William and Mary, did not read his paper upon "Science in Virginia." It is to be hoped that not only it but also the other papers which were read may be speedily published and rendered available for a larger audience.

Lynn Thorndike

Western Reserve University,

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DINNER IN HONOR OF DR. KEEN

ON January 20, 1921, a dinner was tendered to Dr. William Williams Keen, the eminent Philadelphia surgeon, at the Bellevue Stratford Hotel, in Philadelphia, in celebration of his eighty-fourth birthday. Dr. Keen had recently returned from Europe, whither he had gone in the summer of 1920, to preside at the meeting in Paris, of the Société Internationale de Chirurgie, of which he had been elected president in 1914, and the meetings of which had been of necessity suspended during the war. Everywhere abroad he had been received with honors befitting his position as President of this Society, and as the leader and dean of American surgery. It was thought an appropriate time for the friends and admirers of Dr. Keen in this country, to show their appreciation of his many achievements as physician, scientist, educator, man of letters, and patriotic American. The occasion proved to be one of the most remarkable tributes ever tendered a private citizen in Philadelphia. Between five and six hundred subscribers, representing all parts of the country, and all of the learned professions, and the fields of diplomacy, industry, finance, and the public services, joined in honoring Dr. Keen.

The presiding officer and toastmaster was his close friend and colleague, Dr. George E. deSchweinitz, professor of ophthalmology in the University of Pennsylvania, and like Dr. Keen, a former president of the College of Physicians of Philadelphia, the premier medical society of the United States. The speakers, who dwelt on various phases of the activities of Dr. Keen's long and busy life, had all been closely associated with him in one or more of these fields of work. The list included the following gentlemen: Dr. J. Chalmers DaCosta, his one-time assistant, now Gross professor of surgery, in the Jeffer-

son Medical College, in which chair he had succeeded Dr. Keen on the retirement of the latter from active teaching. Dr. William H. P. Faunce, president of Brown University, of which institution Dr. Keen is an alumnus, and of which he has been for many years a most active trustee. Dr. William H. Welch, professor of pathology in Johns Hopkins University, and like Keen a strong exponent and defender of the field of experimental investigation in medicine. The Hon. David Jayne Hill, former ambassador to Germany, who spoke of the interest and efforts of Dr. Keen in the large problems of civic and national welfare, and of his sturdy Americanism. The many letters of congratulation to the guest of the evening had been collected and bound in three volumes, and these were presented by Major General M. W. Ireland, surgeon general of the United States Army, who detailed Dr. Keen's connection with the Medical Department of the Army, beginning with his services in the field and in the hospitals during the Civil War, and down to, and including the World War, when he held a commission as a reserve officer, with the rank of major. A bronze bust, by Samuel Murray, of Dr. Keen in his uniform as an officer of the Medical Corps, U. S. Army, was presented to him on behalf of the subscribers to the dinner, by Dr. William J. Taylor, president of the College of Physicians, and for many years his private assistant.

Dr. Keen responded in happy vein, reviewing the many world changes transpiring during his long life, with special reference to the revolutionary advances in the sciences, and particularly in medicine and surgery, in many of which he had indeed played a leading part. His address is printed below. A reception to Dr. Keen followed the dinner.

John H. Jopson

Philadelphia, Pa.

ADDRESS OF DR. KEEN

As I have listened to what I might call "oral photographs" of myself, I assure you that it has been with genuine humility, as I realized how far short I had come of these fine ideals. I lay no claim to superlative virtues. I am only a loyal American, who, to the best of his ability, has tried to do his daily duty to his fellowmen, his dear country and his God. You have looked on my homely merits with more than kindly eyes, and have regarded my faults and my failings with more than friendly forgetfulness. I thank you again and again from the bottom of my heart.

This bust, the product of Mr. Murray's skill, I accept for myself and my descendants with special pleasure from you, Dr. Taylor, so long my able assistant, later my colleague and always my dear friend. It is the visible evidence of that precious, imponderable, yet all powerful force—the affection of many friends.

What shall I say through you, General Ireland, my distinguished pupil, to the writers of these many letters in three stately volumes. They are generous libations poured out on the altar of Friendship. "Timeo Danaos et dona ferentes" was a valid warning in ancient Troy, but *my* gift-bearing Greeks I welcome with fearless and profound gratitude.

It may be a happy augury that we meet to-day rather than yesterday, the actual anniversary of my birth. By a little stretching of the imagination to-day, I can describe myself as "well along"— a phrase with a truthful indefiniteness—"well along on the way to my 85th birthday," and what is imagination for if not to stand by us when we need help?

To-morrow, in spite of the terrible temptation you have held out to me to do otherwise, I promise you that I shall wear the same Stetson hat as heretofore. I hardly can call it the companion of my youth, but I do treasure it as an old acquaintance which still fits well.

My manner of life from my youth up has been known to you among whom I have lived for four score years and four. It is a source of sincere gratification to me that, in spite of all my faults and shortcomings, of which I am fully conscious, on the whole you seem to approve of it.

When one has reached the altitude of 84, it is natural that he should turn and scan the

far distant horizon and note the outstanding features of his long journey. A brief mention of a few of the more striking events which have occurred during my long life may, therefore, prove of some interest.

My ancestor, Jöran Kyn (George Keen), following the Mayflower pilgrims only 23 years later, left Sweden in the retinue of John Printz, the first Governor of New Sweden, and reached the Delaware River in 1643. He founded the nearby city of Chester. We, his descendants, I think may fairly claim to be truly Americans.

During my lifetime, the United States has (observe *not have* but *has*) grown from a small and isolated nation of only sixteen millions in 1837 to a nation rapidly approaching one hundred and sixteen millions. We have also spread from the Alleghanies to the Pacific. Instead of being isolated, we are bound to all the world by a splendid devotion to Liberty and Law. What a free Democracy can do, even across 3,000 miles of boisterous water, to aid in crushing a tyranny which threatened to engulf the whole world, is the most splendid episode in our entire national history.

Yet how short our life as a nation is may be better appreciated when compared with the life of a single citizen. From the date of my birth, January 19, 1837, back to July 4, 1776, is only 61 years and a half. From that same date to yesterday is 84 years!

One man links me to the first Napoleon, for, in 1862, I assisted the elder Gross in an operation on a Frenchman for a wound received in the Russian campaign of 1812. One woman, my maternal grandmother Budd, links me even with Washington himself. She often related to me how he used to caress her as a young girl, when seeking food and forage from my great-grandfather's farm just across the ridge from Valley Forge in that fearful winter of 1777.

The first six-weeks of my life were spent during the reign of that sturdy old patriot, Andrew Jackson. He and I had at least one thing in common—we were profoundly ignorant of each other's existence. In another matter, our attitudes were miles apart. He was obsessed as to the removal of the deposits of the United States Treasury from that stately building at 4th and Chestnut Streets, while I well recall how utterly indifferent I felt about that exciting subject. But I made the air vibrant if my daily ration was too long delayed.

Long since, I gave up the rather opprobrious phrase "Old Age" and have substituted for it the more seductive locution "accumulated years." The latter connotes a certain joy in continued acquisition, a sort of pride in adding one annual sparkling jewel after another to an already precious store.

I was asked recently how it was that I had managed to accumulate so many years, to which I promptly replied, "Nothing is simpler —don't stop. Just keep right along." Mix merry laughter with earnest labor. Always have some as yet unfinished, but not too urgent job waiting just outside your door. Then you will never know ennui. To "kill time" is murder in the first degree.

William Dean Howells, one of the privileged few who spell their names in the plural because they are such multiplied personalities, in his delightful essay on "Eighty Years and After," first pays his respects to several nonagenarians. He then turns upon those of us who have accumulated ten fewer years (he actually being also one of us) and says, "As to the Octogenarians, there is no end of them; they swarm, they get in one's way."

I humbly crave pardon of any of you if I occupy a place in the sun to which you have a better right than I. Ultimately, no doubt, I shall get out of your way, but do not overlook the fact of my maliciously good health, and that a collateral forbear reached the mature age of 106. The prospect, therefore, of speedy relief, I regret to say, seems rather discouraging. I commend to you the philosophy of life of the woman who, when asked by her minister what passage of Scripture gave her the greatest comfort, promptly replied, "'Grin and bear it' helps me most."

The development of industry, of commerce and of the material things which minister to

man's comfort and health, during my lifetime have been marvellous.

The shrill whistle of the locomotive had been barely heard before 1837, but few there were who foresaw what a revolution in transportation and in industry steam was to produce. Steamships, depending wholly on steam, first ventured across the Atlantic when I was a year old.

The early staccato of the telegraph had also made itself heard, but its future growth and possibilities on land, and under the sea, and in the air could not have been even imagined.

The typewriter, the telephone and the automobile have tripled the efficiency of the doctor. Possibly the airplane in time may quadruple it.

May I venture here to digress for a moment to let you enjoy the recent experience of one of my London scientific friends. In writing a letter he dictated to his secretary, an ardent suffragette, the phase, "When Plancus was Consul," alluding to the friend of Horace to whom he addresses the seventh in the first book of his Odes. What was his amazement to read in the letter presented for his signature, "When *Pankhurst* was Consul." He was so appreciative of the joy that this variant reading would give his friend, that he signed the letter unchanged.

Science has progressed by leaps and bounds. "The most fruitful periods of Science," says Duclaux, in his recent Life of Pasteur, "are those in which dogmas are shaken," that is to say when every postulate is ruthlessly reexamined. This "shaking of dogmas" has given us radio-activity, and has divided the "atom"—that supposed ultimate particle of matter, whose very name means "indivisible"—in some cases into hundreds of electrons.

By the Spectroscope which, in my university days at Brown, existed only in embryo as the curious "Fraunhofer lines" of the solar spectrum, we now analyze the chemical elements of suns many millions of times larger than our own and so distant that the light now reaching our eyes from them started on its earthward journey hundreds of thousands of years ago. Even light itself has been measured and weighed, and Einstein's formulation of the doctrine of relativity is proclaimed as the most fundamental discovery since the days of Sir Isaac Newton.

In 1876, scarcely 45 years ago, electricity had progressed but little beyond the point where Franklin had left it at the time of his death in 1790, just eighty-six years before the Centennial Exposition. Now, the slogan, "If it is not electric, it is not modern" is almost literally true.

At the Centennial Exposition, modern electricity was represented by Professor Farmer's *one arc light* on the roof of the main building, the "avant courier" of a mighty host. The dynamo—appropriately named. Might, Force, Power—had been slowly developing in the brains of Faraday and his successors. Within the last two score years, that giant has been harnessed and has become our obedient slave in heat, light and power, on land and on sea, in mine and in mill. In fact, the catalogue of the things that the dynamo *can not* as yet do would be shorter than the things it *is* actually doing—and the end is not even yet in sight.

My professional life covers sixty-one years of study, active practise, writing and teaching. At its very outset occurred the most fortunate event in my professional life—I fell under the spell of Dr. S. Weir Mitchell. I have met many eminent medical men at home and abroad, but I do not hesitate to say that he was by far the most alert, original and stimulating mind with which I have ever been in contact. I have often called him a "yeasty man" for he leavened and set in fermentation every mind which touched his own. He gave me my first scientific impulse and set congenial tasks for my mind and pen. For over 53 years we worked together in many activities of the profession, with never a cloud between us.

Close upon making his acquaintance came the Civil War. By a curious accident[1] I became an assistant surgeon in the Army on

[1] Keen's "Addresses and Other Papers," p. 421.

July 1, 1861, before I was a graduate in medicine. I knew but little medicine but I replaced a predecessor who demonstrably knew still less, for, at the end of my first year, I coached him for graduation at the end of his second year. I am in doubt whether I ought to be commended or condemned for the result, for he actually succeeded in achieving his diploma.

As to myself, my very ignorance was a safeguard to those under my care for I was indisposed to take any serious risk by heroic treatment. After this service with a regiment of "three months' men," we were honorably discharged August 1, 1861. I then completed my studies and obtained my M.D. in March, 1862. After a real examination, I reentered the service, fortunately for me not in the regulars to which I was entitled, but as an Acting Assistant Surgeon.

Again Mitchell's inspiring touch was vouchsafed to me. At his request, I was assigned, by Surgeon General Hammond, to the neurological ward under Mitchell and Morehouse. I became the junior in what might be called a neurological "firm." "Mitchell, Morehouse & Keen" became very widely known to the profession because Mitchell made it so. His generosity to me when my diploma was hardly dry, in associating my name with his own, already widely known as that of a distinguished physiologist, was as fortunate for me as it was generous upon his part. Our studies, especially in the Turner's Lane Hospital, Philadelphia, laid the foundations of modern Neurological Surgery.

Returning from study in Europe in 1866, I took over the Philadelphia School of Anatomy—founded by Lawrence in 1820—and taught anatomy and operative surgery to large private classes of medical students (1866–1875) when the government took the property for the use of the present postoffice.

From 1866 to 1875, I taught surgical pathology in the Jefferson Medical College. In doing this, I learned ten times as much as my most studious pupil. From 1876 to 1890, I lectured on artistic anatomy in the Pennsylvania Academy of the Fine Arts.

From 1884 to 1889, I was professor of surgery at the Women's Medical College, and from 1889 to 1907, I was professor of surgery in the Jefferson Medical College, a total service as a teacher of 41 years (1866–1907). No one, not himself a teacher, can imagine the joy of that long service. To meet daily scores of earnest, alert minds, greedy for knowledge, was a daily inspiration and developed the most intense desire to give of one's very best.

In 1901–02, with two of my daughters, I made a tour around the world. We penetrated into Java and beyond the Caspian into Turkestan, almost to the western border of China. It is no wonder that, having taught many thousands of students, I was heartily welcomed by some of them in country after country. From the Golden Gate, all the way to Russia, traveling over westward, in Hawaii, Japan, China, the Philippines, India, Egypt, Greece and Palestine, in every land save Java and Turkestan, I had old students. In Korea, also, several were and still are doing splendid service as medical missionaries and others again as teachers in the Medical College in Siam. Even in Persia, there was one—a Persian who returned to his native land as a Christian Medical Missionary. Early in the World War, when the Turks captured Urumiah, where he was dispensing health and happiness to his fellow countrymen, they seized him and gave him the fearful choice—Mohammedanism or the stake—and Joseph Shimoon, the martyr, was burned alive for his faith, by the unspeakable Turk!

The nine epoch-making medical events in the last century and a quarter are:

1. Vaccination against smallpox (1796).
2. Anesthesia (1846).
3. Pasteur's researches were the foundation of the new science of bacteriology (1850 to 1884).
4. Pasteur's chief claim to fame is his further and "fundamental discoveries in immunology, or the science of the specific *prevention* of disease" (Flexner).
5. Pasteur's and Lister's researches resulting in antiseptic and aseptic surgery and obstetrics.

6. The discovery that insects carry disease (1889).
7. The discovery of radio-activity and especially for medical use, the X-rays (1895).
8. The development of a medical literature written by American authors (1859–1920).
9. The founding of great laboratories of research.

With the exception of the first, *every one of these wonderful discoveries has occurred during my own lifetime.*

The first research laboratory was founded in 1884 by Andrew Carnegie, in connection with the Bellevue Hospital Medical College in New York. Others, larger and more elaborate, soon followed, usually in connection with other medical schools. The greatest and most useful of them all is the wonderful Rockefeller Institute for Medical Research, an independent institution in New York City. From that busy center has come one beneficent discovery after another, the last being the discovery by that remarkable genius, Hideyo Noguchi, of the germ of yellow fever, and the preparation of a vaccine which in case of exposure, has proved to be not only a means of protecting those who have never had an attack, but to be actually curative of the fever if administered very early.

In my student days, practically all of our important medical text books were of European, and especially of British origin. The sole exception was the elder Gross's two-volume Surgery (1859) and, twenty years later, Agnew's Surgery in three volumes. Now, there is hardly any department of medicine in which there are not several American text-books of great merit, and our medical journals rival those of Europe.

The first text-book of Surgery in the English language, founded upon bacteriology, the corner stone of modern surgery, was the "American Text-book of Surgery," which I organized, and later, with the assistance of Dr. J. William White, as co-editor, and eleven other American surgeons—published in 1892. It passed through four large editions. I have just finished a still larger work by about 100 American and British authors in eight volumes, averaging 1,000 pages each. It took 18 years of labor ere I could write "Finis" as 1921 was ushered in.

Every intelligent person knows of the actual revolution in surgery, medicine, obstetrics and all the specialties, which has taken place of late years. Anesthesia has robbed surgical operations of nearly all their pain. Antiseptic, and later, aseptic methods, have made the old operations safe, as shown by an unparalleled diminution of the mortality. It has made possible, also, a vast number of operations which were absolutely prohibited in the first twenty years of my professional life, because of their fatality. "Noli me tangere" was writ large on the head, the chest and the abdomen. To-day, we invade these earlier sacrosanct cavities with a free hand and with glorious life-saving results.

Medicine has progressed equally far. We know the causes of various diseases, which we were fighting in the dark until bacteriology revealed to us the realm of the almost infinitely little, but they put the multiplication table to shame by the incredible rapidity of their growth. It is Lilliput versus Gulliver.

Medical science, however, girded up its loins in our laboratories of research and at the bedside, and resolutely attacked the enemy, and has won victory after victory. We learned soon not only the cause but the mode of transmission of these various diseases, especially the remarkable discovery that insects—the mosquito, the louse, the tick, the flea and the fly—and some of the lower animals, especially the dog and the rat, were the means of spreading disease.

The results of these combined discoveries are seen in the imminent banishment from the whole earth of yellow fever, the immense diminution of typhoid, tetanus, diphtheria and other germ diseases, and the curbing of tuberculosis and other diseases, barring, of course, the results of the war.

Maternity, which nature surely intended to be a normal and a safe physiological event, was very dangerous for years after I graduated. The *usual* death rate in the '60's and

'70's was from three to five mothers in every hundred, and sometimes childbed fever raged in epidemic form and killed at the rate of 20, 40 and even 55 mothers in every hundred!

Now, this most beautiful of all human relations has been made safe—mark my words—*made safe* by the researches, especially of Pasteur and his successors. *Bacteriology has won this splendid victory.* Within the last decade, series of 6,000, 7,000 and even over 8,000 cases have been reported *without the death of a single mother from infection.* Is not that a cause for a Te Deum?

But I must call a halt though I have not told even a small fraction of the fascinating story, of what, remember, I have been an enthusiastic living witness.

And what of the future? Have we any reason to expect other astonishing and beneficent discoveries? I answer with an unqualified affirmative. And it may well be still greater and still more beneficent discoveries.

With this word of cheer, I face the coming year or, if it so please God, the coming years, with a confidence which is enhanced by your wonderful tribute of affection.

THE RELATION OF MENDELISM AND THE MUTATION THEORY TO NATURAL SELECTION[1]

Two marked tendencies are evident in the history of any important theory after its publication.

First. The followers of the discoverer carry the theory too far and attempt too universal an application. This is manifestly true of Wallace and Weismann who out-Darwined Darwin in their claims for natural selection; of the followers of Mendel, such as Morgan and Pearl; and of many mutationists who make much greater claims for that theory than does De Vries himself.

Second. Each generation of biologists is so occupied with its own work and contemporary theories that it makes no real effort to understand preceding theories.

This second tendency seems to me most marked in the attitude of present workers along genetic lines towards natural selection. They reveal an apparent lack of understanding of what Darwin really meant and of what he claimed; and when criticising that theory they are often engaged in the classic, but unprofitable, exercise of "fighting windmills,"

In view of these facts I hope you will pardon me if I present in as few words as possible just what I believe to be the main factors which Darwin presented as resulting, in their actions and reactions, in natural selection. These factors are three in number:

First. *Heredity,* by which the progeny tend to resemble their parents more than they do other individuals of the same species.

Second. *Individual variation,* by which the progeny tend to depart from the parental type and sometimes from the specific type.

Third. *Geometrical ratio of increase,* by which each species tends to reproduce more individuals than can survive.

Each of these factors is practically axiomatic, so little is it open to argument.

No one doubts the *fact* of heredity, whether pangenesis, Weismannism or Mendelism be the correct expression of the mechanism involved. These do not affect the *fact* of heredity nor invalidate it as a factor in natural selection.

No one doubts the *fact* of variation; whether it is the "individual variation" of Darwin, the "fluctuating variety" or the "mutation" of De Vries. All that is necessary for Darwin's purpose is that there be heritable variations. That there are such things all parties agree and it matters little what you call them. They are adequate to act as a factor in the Darwinian scheme.

No one doubts the *fact* of geometrical ratio of increase. It is a proposition easily capable of mathematical demonstration, and that it *is* is sufficient for Darwin's purpose.

These three factors, then, are not debatable as facts, whatever their mechanism or causes.

A moment's reflection will show that geometrical ratio of increase is a *quantitative* factor, giving an abundance of individuals

[1] Read before the American Society of Naturalists at Chicago, December 31, 1920.

from which to select; that individual variation is a *qualitative* factor, giving the differences which make a selection possible; and that heredity is a *conservative* factor, holding fast those characters which better fit the organism to its environment.

Now it seems to me that there is no possible outcome of the necessary action and interactions of these three factors that would not be a *selection* of some sort. Darwin thought it comparable in a large way to the selection by which the stock-breeder improves his herd, and therefore called it "natural selection," carefully guarding the phrase from misinterpretation from the teleological angle as well as from a too close parallelism between artificial and natural selection. And I believe no one has suggested a more acceptable term for the process of selection resulting from the interplay of natural laws.

Three outstanding theories have been advanced since the publication of the "Origin," each involving an advance in our knowledge of the mechanism of heredity on the one hand and of the origin of variations on the other.

Weismann's theory of the continuity and stability of the germplasm was of immense importance in its discussion of the mechanism of heredity, and his amphimixis gave a plausible explanation of the origin of variations. His results were almost universally regarded as confirming and greatly extending the scope of natural selection.

Mendel's theory regarding the purity of the gametes, their segregation in the sex cells, and the whole complex Mendelian mechanism so admirably described by Morgan; all of these, fascinating and important as they are, deal with the *mechanism* rather than the *fact* of heredity. In my opinion their acceptance or rejection does not affect the status of natural selection as a theory of organic evolution.

But it is the theory of mutation that has furnished most of the ammunition for the opponents of natural selection; and this in spite of the fact that De Vries, the originator of the mutation theory, expresses himself with great clarity as follows:

> My work claims to be in full accord with the principles laid down by Darwin and to give a thorough and sharp analysis to some of the ideas of variability, inheritance, selection and mutation which were necessarily vague in his time.

In 1904, when these words were published, there did seem to be a sharp distinction between the ideas of Darwin and those of De Vries. The former believed that natural selection acted upon many small variations and accumulated them until the differences were sufficient to constitute new species; while De Vries claimed that new species were formed by the sudden appearance by mutations of forms specifically distinct from the parents. That mutants *were* new species!

It seems evident that Darwin did not regard "saltatory evolution" as the common method, while De Vries did.

Darwin believed that individual, usually small, variations furnished the material on which selection acts; while De Vries thought that mutants, usually large variations, furnished the material. Both, however, believed thoroughly that natural selection was a *vera causa* of evolution.

But things have changed greatly since 1904. The work of Morgan, Castle, Jennings and a host of others has shown that many mutations are so small, from a phenotypic standpoint, that they are quantitatively no greater than the individual variations of Darwin; and that they are heritable in the mendelian way.

Castle produced a perfectly graded series of hooded rats which exhibits almost ideally the steps by which a new form might be produced by natural selection. He says:

> If artificial selection can, in the brief span of a man's lifetime, mould a character steadily in a particular direction, why may not natural selection in unlimited time also cause progressive evolution in directions useful to the organism?

Jennings says:

> Sufficiently thorough study shows that minute heritable variations—so minute as to represent practically continuous gradations—occur in many organisms: some reproducing from a single parent others by biparental reproduction. . . . It is *not* established that heritable changes must be sudden

large steps; while these may occur, minute heritable changes are more frequent. . . . Evolution according to the typical Darwinian scheme, through the occurrence of many small variations and their guidance by natural selection, is perfectly consistent with what experimental and paleontological studies show us; to me it appears more consistent with the data than does any other theory.

Many believers in mutation have been needlessly befuddled by the diverse meanings of "variations" as used by Darwin and De Vries. Darwin included in his "individual variations" both the "fluctuating varieties" and the "mutations" of De Vries. Phenotypically they can not even now be distinguished. De Vries himself candidly admits that this was Darwin's attitude, thus proving himself more clear-sighted than many of his followers. All that Darwin needed for his purpose was proof of variations that are heritable, and these are found in mutations, be they large or small.

Just as mendelism has to do with the *mechanism* and not the *fact* of heredity, so the mutation theory deals with the *nature* and not the *fact* of variations. Neither, in my opinion, has any implication that is antagonistic to the theory of natural selection.

The statement has often been made that natural selection "originates nothing" because it does not explain the origin of variations. I must confess to scant patience with this point of view. As well say that the sculptor does not make the statue because he does not manufacture the marble or his chisel; or that the worker in mosaic originates nothing because he does not make the bits of stone which he assembles in his design!

The material corresponding to the bits of stone in the mosaic is furnished by heredity and variation, and its quantity by geometrical ratio of increase. Natural selection acts in selecting and putting together this material in the formation of new species. Thus, in a true sense, it seems evident that something new has appeared—something that *is* but *was not.*

Another favorite figure, introduced I believe by De Vries, is "Natural selection acts only as a sieve" determining which forms shall be retained and which shall be discarded. This also seems to me to fall short of a complete statement of the truth. If the material subjected to the sifting process be regarded as changing with each generation by the addition of variations, or mutations if you prefer, some of which are favorable to a nicer adjustment of the species to its environment; the figure would be more nearly correct. To make it complete, however, the *mesh* of the sieve must change from generation to generation so that a quantitative variation which would be preserved in one generation would be discarded in a later one. But in this case natural selection would do more than a sieve could do. It would combine a number of favorable variations in the production of something new, a *new species!*

In conclusion it seems to me that we are justified in maintaining that Mendelism and the mutation theory, while forming the basis of the most brilliant and important advances in biological knowledge of the last half century, have neither weakened nor supplanted the Darwinian conception of the "Origin of species by means of Natural Selection."

C. C. Nutting

SCIENTIFIC EVENTS

PROFESSOR CALMETTE ON A VACCINE FOR TUBERCULOSIS

The Paris correspondent of the *London Times* reports that the *Petit Journal* publishes an interview with Professor Calmette, subdirector of the Pasteur Institute, which indicates that progress has been reached in the long struggle of the medical profession to find a cure for the ravages of tuberculosis. Professor Calmette was careful to tell his interviewer not to proclaim too widely that a cure has been found. "We are only at the dawn," he said. "The possibilities are immense, I can assure you, but we have still much work before us . . . in following the pathway which now lies open before us and which will lead us perhaps to a splendid realization of our hopes. Hope is now permissible."

Professor Calmette then gave an account of the results of his researches and those of Dr. Guérin, which proved that cattle and monkeys could be given immunity. A vaccine has been found for cattle. Experiments lasting over many months have given results said to be of importance.

Professor Calmette stated that in a certain stable they placed five known tuberculous cows. With them were housed ten heifers, four of which had not been given an effective vaccine, and the other six had been vaccinated. The trial lasted for thirty-four months, some of the cattle being revaccinated each year. At the end of the time, when the beasts were slaughtered, it was found that of the four unvaccinated heifers three showed advanced tuberculosis. Of the six vaccinated beasts the two which had only once been vaccinated showed distinct signs of the disease, but the four animals which had been vaccinated three times, although they had been in constant company with the tuberculous companions for thirty-four months, showed no trace of the disease. Further experiments on a large scale are now going on.

To find out whether this vaccine is capable of being applied to man experiments will be necessary on chimpanzees and anthropoid apes. These animals do not take kindly to temperate climates, and Professor Calmette and his collaborators have therefore decided to build an experimental laboratory in French Guinea. The Pasteur Institute has obtained the concession of Rooma Island, four miles from Konakry, for their researches, and the governor of Western Africa has put at the institute's disposal from the 1921 budget the sum of about £6,000, with which the laboratories will be constructed. The researches of the scientific missions will take some years, and the estimated expenditure is £5,000 a year.

AWARDS OF THE PARIS ACADEMY OF SCIENCES

According to the report in *Nature* the prizes awarded by the Paris Academy include the following:

Mathematics.—Grand prize of the mathematical sciences to Ernest Esclangon, for his memoir entitled "New Researches on Quasi-periodic Functions"; the Poncelet prize to Elie Cartan, for the whole of his work; the Francœur prize to René Baire, for his work on the general theory of functions.

Mechanics.—A Montyon prize to Stéphane Drzewiecki, for his book on the general theory of the helix, with reference to marine and aerial propeller-blades; the de Parville prize to Jean Villey, for his work on internal-combustion motors.

Astronomy.—The Lalande prize to Léopold Schulhof, for his revision of the catalogue of the proper motions of 2,641 stars; the Valz prize to Ernest Maubant, for his work on the calculation of the perturbations of comets; the Janssen medal to William W. Coblentz, for his work on the infrared radiation of terrestrial sources and of stars; the Pierre Guzman prize between François Gonnessiat (5,000 francs), for his work on the photography of the minor planets; René Jarry-Desloges (5,000 francs), for his physical observations on the planets, especially Mars, and Joanny-Ph. Lagrula (4,000 francs), for his work on the rapid identification of the minor planets.

Geography.—The Delalande-Guérineau prize to Georges Bruel, for his explorations and publications relating to French Equatorial Africa; the Tchihatchef prize to Auguste Chevalier, for his explorations in Africa and Indo-China; the Binoux prize to Marcel Augiéras, for his work in the western Sahara.

Navigation.—The prize of 6,000 francs between Fernand Gossot (4,000 francs), for his treatise on the effects of explosives, Pierre de Vanssay de Blavous (1,500 francs), for the whole of his work, and René Risser (500 francs), for his work on ballistics.

Physics.—The L. La Caze prize to Georges Sagnac, for the whole of his work in physics; the Hébert prize to Léon Bouthillon, for his work on wireless telegraphy; the Hughes prize to Frédéric Laporte, for his work on electrical standards and the photometry of electric lamps; the Clément Felix foundation to Amédée Guillet, for his researches on chronometry.

Chemistry.—The Montyon prize (unhealthy trades) to Léonce Barthe, for his work on the hygiene of workshops; the Jecker prize (5,000 francs) between Henri Gault, for his work in organic chemistry, and Henri Hérissey, for his researches on the glucosides of plants; the L. La

Caze prize to Robert de Forcrand, for his work in inorganic chemistry.

Mineralogy and Geology.—The Fontannes prize to Olivier Couffon, for his work entitled "Le Callovien du Chalet (Commune de Montreuil-Bellay)"; the Joseph Labbé prize to Albert Bordeaux, for his applications of geology to the solution of mining problems. The Victor Raulin prize is postponed until 1921.

Botany.—The Desmazieres prize to André Maublanc, for his work in mycology and plant diseases; honorable mention to Pierre Sée, for his book on the diseases of paper; the De Coincy prize to Lucien Hauman-Merck, for the whole of his botanical work. The Montagne prize is not awarded.

Anatomy and Zoology.—The Cuvier prize to Alphonse Malaquin, for the whole of his work in zoology; the Savigny prize to F. Le Cerf, for his "Revision des Ægeriidés algériens"; the Jean Thore prize to A. Cros, for his biological studies of the Coleoptera of northern Africa.

THE UNIVERSITY OF LONDON'S PHYSIOLOGICAL LABORATORY

At its meeting in December the senate of the University of London decided that the physiological laboratory must be closed at the end of July next unless assurance of adequate support is received from the London County Council or other sources. *The British Medical Journal* writes:

The laboratory was established under the direction of Professor A. D. Waller, F.R.S., in 1902, at the headquarters of the university in the Imperial Institute, South Kensington, the equipment being provided out of a fund of £4,000 provided from private sources. It has since been maintained partly out of university funds and partly by private assistance, with the help, during the last nine years, of an annual grant of £500 from the London County Council. This grant is now to be withdrawn, and the university has no funds out of which to make up the deficit. In deciding to close the laboratory, the senate appears to be influenced also by the need of finding additional room in its present quarters for general university purposes; this is indicated by a further resolution stating "that should adequate support for the transference and maintenance of the physiological laboratory be forthcoming, the laboratory be continued during the pleasure of the senate elsewhere than in its present quarters, which shall be vacated not later than the end of July, 1921." Physiologists will agree with Sir E. Sharpey Schafer that the closure of the laboratory would be a serious misfortune. "It is," he says, in a letter to the *Times*, "unique from the fact that, being unattached to any particular medical school or college, it has been untrammelled by the necessity of providing elementary teaching in physiology, and has been able to devote all its energies to research. The success it has obtained in this under the able guidance of the director, Professor A. D. Waller, is universally acknowledged. The originality of Professor Waller's methods and the brilliant results which have been obtained from their application—especially in the difficult subject of electrophysiology—are well known. It would be a real calamity if a sudden stop were put to these activities." It is suggested that the reason why the London County Council has withdrawn its contribution at this time is the expectation that it will shortly have to contribute a large sum toward the cost of building new university headquarters. "It would seem," Sir E. Sharpey Schafer concludes, "a pity to allow an active laboratory to be abolished in order to save £500 a year towards the cost of problematical buildings." "Problematical," perhaps, is not quite the right word, because, we presume, something will have to be done for the university, but no building can be undertaken for some considerable time to come. We can only express the hope that, should the London County Council remain obdurate, public-spirited benefactors, recognizing the importance of the university having at least one research laboratory, will come to the rescue. We may, at any rate, express the expectation that means will be found to carry on the laboratory until the question of the new site for the university is settled.

POPULAR LECTURES ON SCIENTIFIC SUBJECTS AT THE CALIFORNIA ACADEMY OF SCIENCES

With the opening to the public of the new Museum of the California Academy of Sciences in Golden Gate Park, San Francisco, in 1916, one of the activities of the educational policy put into effect by Dr. Barton Warren Evermann, the director of the museum, was courses of popular lectures on scientific subjects of general interest. These courses began in the fall of 1916 and have been continued each year since, without interruption except during the summer months. The lectures are given at three o'clock each

Sunday afternoon in the museum auditorium. Among the lecturers have been many of the most distinguished men of science on the Pacific coast and a number from the east. The courses for the present year are proving of unusual interest. Those given in the first part of the year have already been mentioned in SCIENCE. Those for the first months of 1921 have been announced by Director Evermann as follows:

Three lectures by Professor Lewis, of the University of California, as follows:

January 2. "Atoms and ions." Illustrated.

January 9. "Electrons and positive rays." Illustrated.

January 16. "Radioactive transformations." Illustrated.

Three by Professor D. L. Webster, of Stanford University, will be as follows:

January 23. "General properties of X- and Gamma-Rays." Illustrated.

February 6. "X-Ray spectra." Illustrated.

February 13. "The structure of atoms." Illustrated.

On January 30 Dr. E. C. Slipher, Lowell Observatory, Flagstaff, Arizona, lectured on: "Photography of the planets, with special reference to Mars." Illustrated.

Upon the completion of this course on physical subjects other lectures will be given as follows:

February 20. Mr. Edward Berwick, Pacific Grove, Calif., subject: "How Uncle Sam's money is wasted."

February 27. Dr. Harlow Shapley, Mount Wilson Solar Observatory, Pasadena, subject: "The dimensions of the stellar universe." Illustrated.

March 6. Major W. B. Herms, associate professor of parasitology, University of California, subject: "Eighteen thousand miles in search of mosquitoes in California—how and why?" Illustrated.

March 13. Mr. Harry S. Smith, entomologist, State Department of Agriculture, Sacramento, subject: "Parasitism among insects."

March 20. Dr. E. C. Van Dyke, assistant professor of entomology, University of California, subject: "Some injurious forest insects of California."

March 27. Mr. Frederick Maskew, formerly chief deputy quarantine officer, State Department of Agriculture, subject: "Insect quarantine work of the State Department of Agriculture."

April 3. Dr. R. S. Holway, associate professor of physical geography, University of California, subject: "The evolution of California scenery." Illustrated.

April 10. Dr. B. L. Clark, assistant professor of paleontology, University of California, subject: "Ancient seas and their faunas." Illustrated.

April 17. Dr. G. D. Louderback, professor of geology, University of California, subject: "Chief events of earth history in the California region." Illustrated.

April 24. Dr. Chester Stock, research assistant, department of paleontology, University of California, subject: "The former mammalian life of California." Illustrated.

Upon the completion of the above there will be five lectures in May on the general subject of meteorology. This course is being arranged by Mr. E. A. Beals in charge of the United States Weather Bureau Office, San Francisco. The subjects and speakers will be announced later.

SCIENTIFIC NOTES AND NEWS

DR. THEODORE LYMAN, professor of physics and director of the Jefferson Physical Laboratory, Harvard University, has been elected president of the American Physical Society.

THE Edison medal, awarded annually for work in electrical engineering by the American Institute of Electrical Engineers, will be presented this year to Dr. M. I. Pupin, professor of electromechanics at Columbia University.

DR. IRA REMSEN, president emeritus of the Johns Hopkins University, professor of chemistry emeritus at the institution, has accepted an offer from the Standard Oil Company to act as consulting chemist for the corporation.

DR. PEARCE BAILEY has been awarded a distinguished service medal in recognition of his services as chief of the division of neuro-psychiatry of the Surgeon-General's Office.

KING GEORGE has signified his intention of conferring the honor of knighthood on Dr. Maurice Craig, consulting neurologist to the Ministry of Pensions, and Dr. P. Horton-

Smith Hartley, senior physician at the Hospital for Consumption and Diseases of the Chest, Brompton.

The pupils and friends of Professor E. Morselli recently celebrated the fortieth anniversary of his incumbency of the chair of psychiatry at the University of Genoa. The celebration occurred during the Italian Congress of Neurologists and Alienists, held at Genoa in his honor. A copy of Raphael's Madonna of the Candelabra, in a sixteenth century frame, was presented to him by public subscription.

The Geological Society, London, has made the following awards: Wollaston medal, Dr. John Horne and Dr. B. N. Peach; Murchison medal, Mr. E. S. Cobbold; Lyell medal, Dr. E. de Margerie, director of the Geological Survey of Alsace-Lorraine; Bigsby medal, Dr. L. L. Fermor, Geological Survey of India; Wollaston fund, Dr. T. O. Bosworth; Murchison fund, Dr. Albert Gilligan; and Lyell fund, Professor H. L. Hawkins, Reading University College, and Mr. C. E. N. Bromehead, H.M. Geological Survey.

The Paris Academy of Medicine has elected the following officers for the year 1921: *President,* Dr. Richelot; *Vice-president* (president for 1922), Professor Bourquelot, and *Annual Secretary,* Professor Achard.

Herbert E. Gregory, professor of geology at Yale University and director of the Bishop Museum in Honolulu, has returned to the Hawaiian Islands.

Dr. Oskar Klotz, professor of pathology and bacteriology at the University of Pittsburgh, will sail on February 9 for São Paulo, Brazil, to assume for a two-year period the directorship of the pathological laboratories at the University of São Paulo, under the auspices of the Rockefeller Foundation.

Professor Charles J. Tilden has been granted a leave of absence from Yale University, where he was called to reorganize the engineering courses a year ago, to become director of the Highway Education Committee appointed by the federal commissioner of education.

Dr. L. A. Mikeska has accepted a position on the staff of the Rockefeller Institute, New York City, having left the Color Laboratory of the Bureau of Chemistry in Washington, D. C., where he was working on photosensitizing dyes.

Dean A. Pack, Ph.D. (Chicago), has been appointed plant breeder in the Office of Sugar-Plant Investigations, Bureau of Plant Industry, U. S. Department of Agriculture. Dr. Pack has charge of the sugar beet seed breeding work for the department in the Intermountain States, with headquarters at Salt Lake City, Utah.

Dr. J. C. Witt, assistant professor of analytical chemistry in the University of Pittsburgh, has resigned to become chief research chemist for the Portland Cement Association with headquarters in Chicago. Dr. Witt has been succeeded in his former position by Dr. C. J. Engelder, of Hornell, N. Y.

Mr. Thomas M. Rector, formerly in charge of the division of food technology of the Institute of Industrial Research, Washington, D. C., has been appointed director of the department of industrial chemistry of the Pease Laboratories, Inc., New York City.

Dr. Edgar Fahs Smith, formerly provost of the University of Pennsylvania, made an address on February 11, on "Research," before the New York Section of the American Electrochemical Society in joint session with the American Chemical Society, the American Section Society of Chemical Industry and the American Section of Société de Chime Industrielle.

Dr. J. S. Plaskeet, director of the Dominion Astrophysical Observatory, Victoria, B. C., delivered two addresses at the University of Washington on January 19 and 20, the one on "Modern ideas of the universe," and the other on "The chemistry of the stars." These lectures were held under the auspices of the University of Washington Chapter of Sigma Xi, the Puget Sound Section of the American Chemical Society and the Puget Sound Section of the American Institute of Electrical Engineers.

We learn from *Nature* that Dr. E. W. Scripture has lately returned from Germany, where he has been lecturing on experimental phonetics applied to the study of English. Dr. Scripture, who was formerly assistant professor of experimental psychology in Yale University, and associate in psychiatry in Columbia University, is now resident in London, where he has been for some years engaged on studying records of speech in epilepsy, general paralysis and other nervous diseases.

At the annual general meeting and conversazione of the Harveian Society of London, held on January 13, Dr. Turtle was elected president for the ensuing year. The retiring president, Dr. Hill, delivered an address on the advances in the methods of treatment of disease of the œsophagus during the present century.

Six Hunterian lectures on the "Principles of human craniology," illustrated by specimens and preparations, were delivered by Professor Arthur Keith at the Royal College of Surgeons, during January.

The Osler Society for the Study of Medical History has been organized by a group of twelve physicians of the Mayo Foundation. Dr. William C. MacCarty, associate professor of pathology, has been elected president of the society.

A committee has been appointed to undertake a campaign for the collection of a fund of $500,000 for the endowment of two memorials to the work of the late Dr. Henry Baird Favill, of Chicago. It is proposed to create a Henry Baird Favill Memorial Laboratory, with fellowship endowments, in St. Luke's Hospital, to the interests of which Dr. Favill devoted many years of special effort. For this purpose a fund of $250,000 is solicited. A like sum is desired for the establishment of the Henry Baird Favill Foundation, the income of which shall be used for the promotion of public instruction in health and hygiene. Mr. Edgar A. Bancroft is chairman, and Mr. N. D. Sibley is secretary of the committee.

A bronze tablet was recently unveiled in the medical laboratory of the University of Rio de Janeiro to commemorate the work there of Professor Diogenes Sampaio, who died in 1918. He was influential in the organization of the laboratory which is henceforth to bear his name.

Dr. Hugh A. McCallum, dean of the Western University Medical School of London, Canada, died on January 25.

Sir Lazarus Fletcher, keeper of minerals in the British Natural History Museum from 1880 to 1909 and then director of the museum until 1919, died on January 6, in the sixty-seventh year of his age.

Dr. Odoardo Beccari, director of the Botancal Garden at Florence, known for his explorations in New Guinea from 1860 to 1870, and as an authority on the classification of palms, died at Florence on October 25.

The death is announced of Dr. Wilhelm Foerster, professor of astronomy at the University of Berlin, at one time director of the Royal Observatory. Dr. Foerster was born at Grunberg, Schleswig, December 16, 1832.

Professor C. George Schillings died in Berlin, on January 29, aged sixty-five years. He was known for his travels in East Equatorial Africa and his studies of African zoology.

The United States Civil Service Commission announces an open competitive examination for psychologist in the Public Health Service throughout the United States at a salary of $2,200 a year, or with quarters and subsistence $1,600. Applicants must have graduated from a college or university of recognized standing and have had at least three months of experience in normal psychology. They should apply, before March 15, to the Civil Service Commission, Washington, D. C.

The annual meeting of the American Medical Association is to be held in Boston, June 6–10, under the presidency of Dr. Hubert Work, Pueblo, Colo.

The American Psychological Association will hold its thirtieth annual meeting at Princeton on December 28, 29 and 30, 1921.

THE spring meeting of The American Society of Mechanical Engineers will be held in Chicago at the Congress Hotel, from May 23 to 26. Sessions are planned by the professional sections on aeronautics, fuels, management, material handling, machine shop, power, forest products and railroads.

THE *Journal* of the American Medical Association states that investigations made by the Rockefeller Foundation indicate that the countries of central Europe, with the possible exception of Austria, suffer from a shortage of physicians. Thus, in Poland less than 2,000 physicians are said to be available to care for the 25,000,000 inhabitants, and in Serbia it is stated there are less than 300 physicians outside of the army medical officers. In its efforts to rehabilitate the medical schools of central Europe, the Rockefeller Foundation has decided to aid in the establishment of a high grade medical school at Belgrade.

A SPECIAL committee from the Petrograd Academy of Science has proposed a plan to the academy, whereby a closer contact between the scientific men of Russia and Western Europe may be forwarded.

ON December 31 the Zoological Society at Hamburg decided to close the Zoological Gardens because the city can not afford to aid in maintenance.

MRS. EUGENE SILLIMAN BRISTOL has given $1,000 to the proposed Silliman fund, the income of which will be applied to the maintenance of the *American Journal of Science*.

UNIVERSITY AND EDUCATIONAL NEWS

DR. WALLACE W. ATWOOD, lately professor of physiography at Harvard University, was inaugurated as president of Clark University, on February 1.

DR. W. B. CANNON, professor of physiology, and Dr. Otto Folin, professor of biological chemistry, at Harvard University, were last autumn, offered research positions in the Mayo Clinic at Rochester, with all possible facilities for the conduct of research work and with salaries approximately twice those given by the university. They have, however, decided to remain at Harvard.

PROFESSOR F. C. NEWCOMBE, of the department of botany of Michigan University, has been granted leave for the second semester of the current year. His mail address will be Palo Alto, Calif. During Professor Newcombe's absence Professor H. H. Bartlett will be administrative head of the department.

DR. EARNEST ALBERT HOOTON has been appointed assistant professor of anthropology at the Harvard Medical School, and Dr. William Lorenzo Moss, assistant professor of preventive medicine and hygiene.

DR. G. W. A. LUCKEY, formerly dean of the school of education of the University of Nebraska, has been appointed specialist in foreign education in the U. S. Bureau of Education, Washington.

DISCUSSION AND CORRESPONDENCE

THRICE TOLD TALES

TO THE EDITOR OF SCIENCE: Referring to the letter of Professor Wood,[1] I, also, have a story about the Lick Observatory and to enable Professor Wood to have a whack at it I hasten to offer it to the public. In the summer of 1891 I was the guest of the then director of the observatory, Professor E. S. Holden, for a week or ten days while making a series of gravity measurements and I was greatly interested in the "public nights," in the establishment and maintenance of which the institution has done a most admirable piece of work.

On one of these occasions I was watching the long line of visitors formed near the big refractor, each awaiting his turn for a look through that wonderful instrument. The object to which it was directed at that time was a star cluster and, as every one knows, when a cluster is viewed through a telescope the number of stars seen is increased enormously and those visible to the naked eye are greatly en-

[1] SCIENCE, January 14, 1921.

hanced in brightness and although a glorious sight there is no showing of round disks like the sun, moon or the near planets when examined in the same way.

In some way my attention was drawn to a man somewhat back from the head of the line who seemed to be in a condition of tense excitement over the experience in store for him. He may have traveled hundreds of miles (as they do in California) for the opportunity of viewing the heavenly bodies with the aid of the enormous glass and, impatient with those ahead of him who lingered somewhat at the eye-end of the telescope, he seemed to fear lest the world should come to an end before his turn came. Having observed (I have no doubt a very common experience) that the first look through a large telescope or a microscope of very high power is generally a disappointment, I quietly "attached myself" to this man and was at his side when at last his chance came. He had been told the nature of the object and eagerly putting his eye to the eye piece he stood perfectly motionless for one long minute. Then, after glancing around to see if any of the members of the "staff" were near by, and assuming, doubtless, that I belonged to the "line," he held his open hand by his mouth to prevent the spread of his voice and hissed into my ear the words *"damned fraud."*

I have told this story several times in the last quarter of a century, having thought it a rather good one and before Professor Wood despoils me of it by "running across it" in the Novum Organum, the Principia, the Dowager Duchess Cristina's account of her visit to Galileo's Observatory or some other old place, I hope he will remember that constructive criticism is the only thing that goes these days and that a good story should never be "scrapped" except for the purpose of making a better one.

T. C. Mendenhall

P. S. This letter might be indorsed, "Attention Mr. David Wilbur Horn," another iconoclast who on the same page shows a disposition to rob us of the charming picture of the young Galileo standing amidst his Aristotelian enemies at the foot of the tower of Pisa (though Professor Cajori has him at the top I insist that he must have been at the bottom in order to witness the effect of his experiment upon his opponents) calmly and confidently awaiting the arrival of the two balls simultaneously released at the top.

Have we not believed that imagination was a *sine qua non* in the equipment of a man of science? Even the swinging lamp in the Duomo has been robbed of its romance by the discovery that it was not in existence in Galileo's day. We may cling to the rope by which it is suspended, however, for, as far as I know, no one has yet proved that it is *not* the actual thing whose vibrations the young philosopher found to be isochronous.

And before it is too late I hope some enterprising company will "film Archimedes springing from his bath and running into the street, naked as a pair of his own compasses."

T. C. M

To the Editor of Science: Apropos of thrice told tales, as illustrated by the communication of Mr. Wood in Science January 14, 1921, I may point out that the familiar story of Lincoln, in his young days, nailing a lie in court by showing the witness lied when he said he saw the deed done in the moonlight, because the moon was not at that date in the sky at night, is found practically the same, when ascribed to different occasions by

(1) Plutarch in the life of Alcibiades as to the desecration of the statues of Hermes.
(2) Chambers' "Book of Days," Lippincott ed., Vol. I., p. 14, in another court scene.
(3) "Lincoln, the Lawyer," by Frederick Trevor Hill, p. 230 seq.

The human mind runs easily and copiously in well-worn channels and one may easily construct plausible hypotheses, without introducing that of plagaiarism. I have recently seen the story of the lesson taught by the stars ascribed, I think, to still a fourth source, which I now forget. There are so few really good stories we might well allow them to travel as far and as long as they continue to instruct and amuse, without going too deeply into the question of the absolute varacity of

those who pass them along. A good story should never be spoiled by that.

JONATHAN WRIGHT

PLEASANTVILLE, NEW YORK,
January 18, 1921

REPLY TO PROFESSOR HORN

MANY times has the undersigned been found to be in error on historical questions. It is not easy to write during a period of over thirty years without occasionally committing mistakes. Even Newton once said, "It's impossible to print the book without faults." However, it is due to myself to state that not all the errors attributed to me are errors in reality. In not a few cases the critics themselves are in error. But never, before the appearance of Professor D. W. Horn's letter (SCIENCE, January 14, 1921), have I been accused of "Romancing in Science." Had Professor Horn been less excited and more contemplative, he would have written differently. My account of Galileo was prepared a quarter of a century ago. Were I to re-write it, I would make some slight changes. "Prior to Galileo it did not occur to any one actually to try the experiment" relating to acceleration. More recent research reveals that Galileo, like most great scientific men, had his forerunners. I say that Galileo publicly experimented "one morning." This may have been the correct time of day, but I am not now able to verify the statement. Galileo "allowed a one pound shot and a one hundred pound shot to fall together." From Galileo's "Dialogues Concerning two New Sciences" it appears that he did perform this experiment, but I am not sure that these were the particular weights used when experimenting before the university assembly. I have gone over sentence by sentence the passage quoted by Professor Horn and the above are the only changes which seem to me perhaps necessary. I repel as unjust the charge that I am "romancing in science."

Dr. Partridge rendered a service in calling attention to Galileo's experiments at the Tower of Pisa. However, I still think that the Doctor overstated his case, was wrong in implying that Galileo made only one experiment, and without sufficient reason called in question the accuracy of Viviani's "Life of Galileo"—a life which Favaro, after very many years devoted to the study of Galileo, has found to be remarkably reliable. Of course, part of the discussion hinges on the word "exactly." No description of an experiment can be exact in every detail. However, if essentials suffice, then our knowledge of Galileo's experiments on falling bodies is exact, for we know exactly the purpose of the experiments, as well as the mode of experimentation, namely, the dropping of different weights of a variety of materials—mention being made of some of the materials dropped.

Professor Horn quotes: *Fortis imaginatio generat causum.* I agree, but whose *casus* is it really?

FLORIAN CAJORI

UNIVERSITY OF CALIFORNIA

A CORRECTION

TO THE EDITOR OF SCIENCE: The times are actually worse than I realized when writing recently about "Romancing in Science." The opening quotation should have read "O tempora," instead of "O tempus." The peculiar appropriateness of this quotation is apparent, for the correction came to me (from New York) as part of an *anonymous* letter!

DAVID WILBUR HORN

BRYN MAWR, PENNSYLVANIA

MEMOIR OF G. K. GILBERT

THE undersigned is engaged in the preparation of a memoir of the late G. K. Gilbert, to be published by the National Academy of Sciences, and would be obliged if geologists and others who possess letters from him or who recall incidents that throw light upon his character would submit them for incorporation in the story of his life. His great contributions to geological science are published and fully accessible; but the smaller non-scientific matters which give the life of a man its finer savor can be learned only by personal communication from his friends. A good number of such communications have been already received; they are of so great

interest that many more are desired. As an example the following may be instanced: A well-known scientist in whose home Gilbert was a frequent guest, warmly welcomed by father, mother, and children, writes that one of his boys, when a little fellow, became so fond of the visitor that he for a year or so wound up his evening prayer with an added petition of his own invention—"O Lord! bless father, and mother, and Mr. Gilbert, and some ladies." It is often written of an eminent man that he was fond of children, but it is rare to find testimony as spontaneous and convincing as this to show that children were fond of him.

W. M. Davis

Cambridge, Mass.,
January 27, 1921

QUOTATIONS

THE PRINTING OF ASTRONOMICAL OBSERVATIONS

Printing has become so expensive that it will be necessary to revise some of our existing practises, and especially that with regard to original observations. There is an undoubted convenience in printing original observations just as they are made, for, however carefully they are discussed at the time, the general advance of astronomy may later provide an improved basis for discussion. Thus, old observations of position, such as those of Bradley or Groombridge, gained much from the growth in knowledge of instrumental errors, and old observations of variable stars have been rediscussed with advantage now that better magnitudes of comparison stars are available.

There is no reason to anticipate finality in improvement, and it is therefore a convenience to have the original material widely accessible; but one may have to pay too dearly for this convenience, and it looks as though the recent advance in prices had brought this contingency about. We have have to be satisfied to store a fair copy of the original observations in some accessible place, such as the library of the Royal Astronomical Society or of a well-known observatory. Perhaps it would be better to store two copies, one of which might be freely lent on demand, but not the other. There is, moreover, this to be said in favor of this more economical policy—it is not *always* the case that these original observations improve in value with time. No doubt they improve just at first, but something may happen which compensates the advantage of lapse of time; even Bradley's observations are to-day of historical rather than scientific interest, in comparison with modern observations, as Boss maintained stoutly years ago and others reluctantly admitted later. Micrometer measures of clusters by such careful observers as Pogson and Baxendell are to-day really not worth discussing; a couple of photographs at a few years' interval give better proper-motions—far better—than could be deduced by the use of these early micrometer measures. Hence the policy of holding up the printing of observations may in *some* cases obviate the need for printing at all; but if it is adopted, I would strongly urge the alternative of depositing a fair copy in some well-known library. And I may, perhaps, quote a particular instance to point the moral: recently I was interested in a particular variable of which maxima had been recorded by a particular observer nearly half a century ago; I got into communication with him, and found that he had given up observing and so far forgotten his own devoted work as to deny at first that he had ever made such observations! But he was good enough to ransack his papers, found the observations, and very kindly sent me a copy of them. They were of great value, and though perhaps it is going too far to say that they might have been lost, still it must be admitted that there was some risk of this disaster. Hence I should repeat the maxim deduced from my own experience and previously given in the form "when you have made five years' observations publish them" in a new dress:—"*Either* publish them, *or* deposit a fair copy in some well-known library, publishing an intimation to that effect."

As I have made reference to this increased cost of printing, may I call the attention of

other nations, who may not be similarly affected, to our altered circumstances? Before the war we welcomed papers from distant contributors almost unreservedly; our attitude towards such contributors personally is in no way changed, but our purses are not so full or are more rapidly emptied. We would ask them kindly to think twice before sending to us a paper which could just as well be printed in their own country; but I should add that this suggestion has no official character whatever, and is made on purely personal responsibility.—From an Oxford Note-Book in *The Observatory*.

SPECIAL ARTICLES

ON THE STABILITY OF THE ACID-BASE EQUILIBRIUM OF THE BLOOD IN NORMAL AND IN NATURALLY NEPHROPATHIC ANIMALS[1]

In a recent number of this journal[2] a note was published which had as its object a discussion of the influence of the age of an organism in maintaining its acid-base equilibrium. In this paper the observation was made that when animals of different ages were intoxicated by uranium nitrate, the factor of the age of the organism in the reaction was expressed by an inability of the senile animal to maintain with the same degree of perfection a normal acid-base equilibrium as was the case with the younger animal. More recently studies have been undertaken which have had as their object an investigation of the stability of the acid-base equilibrium of the blood in naturally nephropathic animals following the use of an anesthetic,[3] and of the ability of an alkali to protect the naturally nephropathic kidney against the toxic effect of an anesthetic.[4] As a result of these studies the observation has been recorded that following the use of an anesthetic a greater disturbance in the acid-base equilibrium of the blood was induced in a naturally nephropathic animal than occurred in a normal animal. Furthermore, a more adequate degree of protection could be obtained in a normal dog against an anesthetic by the use of a solution of sodium bicarbonate than could be obtained in a naturally nephropathic dog.

The following study is concerned with an investigation of the stability of the acid-base equilibrium of the blood in naturally nephropathic animals as contrasted with normal control animals when this equilibrium is upset by the intravenous injection of an acid or an alkali.

Twenty-six dogs have been used in this series of experiments. Ten of the animals were normal and were employed as controls for the sixteen naturally nephropathic animals. The animals were anesthetized by ether. A glass canula was inserted into the femoral vein and connected with a buret. Through this connection the acid or the alkali was introduced into the animal's circulation. At the end of half an hour of etherization the reserve alkali of the blood (R.p.H.) was determined by the method of Marriott.[5] Blood for this purpose was obtained by puncturing the saphenous or external jugular veins. After making the initial determination of the animal's alkali reserve, both the normal control animals and the naturally nephropathic animals received intravenously either 5 c.c. per kilogram of a $n/2$ solution of hydrochloric acid or 25 c.c. per kilogram of a three per cent. solution of sodium bicarbonate. Determinations of the alkali reserve of the blood were made in both groups of animals at fifteen minute intervals during the first hour

1 Aided by a grant from the Rockefeller Institute for Medical Research.

2 MacNider, William deB., "Concerning the Influence of the Age of an organism in maintaining its Acid-base Equilibrium," Science, N. S., Vol. XLIV., 643, 1917.

3 MacNider, William deB., "I. A Study of the Acid-base Equilibrium of the Blood in Naturally Nephropathic Animals and of the Functional Capacity of the Kidney in Such Animals following an Anesthetic," *Jour. Exp. Med.*, Vol. XXVIII., 501, 1918.

4 MacNider, William deB., "I. A Study of the Efficiency of an Alkali to Protect the Naturally Nephropathic Kidney against the Toxic Effect of an Anesthetic," *Jour. Exp. Med.*, Vol. XXVIII., 517, 1918.

5 Marriott, W. McK., "A Method for the Determination of the Alkali Reserve of the Blood Plasma," *Arch. Int. Med.*, Vol. XVII., 840, 1916.

of the experiment and at half hour intervals during the final hour.

The normal alkali reserve of the blood for the control group of animals has varied from 8.0 to 8.1. When such animals are given intravenously 5 c.c. per kilogram of a $n/2$ solution of hydrochloric acid there occurs within fifteen minutes a reduction in the alkali reserve of the blood which, in the normal animal of Experiment 4 that is representative of the group, was 7.85. In these animals there occurs at once an attempt to restore the normal acid-base equilibrium. Within the second fifteen-minute period of Experiment 4 the alkali reserve had increased from 7.85 to 7.95, and at the end of one hour the reading was 8.0. At the termination of the experiment the alkali reserve was 8.05, as opposed to the normal of 8.1.

The remaining five normal animals received intravenously 25 c.c. per kilogram of a three per cent. solution of sodium bicarbonate. The response of these animals to the introduction of such a solution has been of the same type. The animal of Experiment 7 had a normal alkali reserve of the blood of 8.1. At the end of fifteen minutes following the introduction of the solution of sodium bicarbonate the alkali reserve was increased to 8.3. Within half an hour, as a result of the attempt on the part of the animal to reestablish a normal acid-base equilibrium, the reading was 8.2. At the end of the first hour the normal reading of 8.1 had been established and remained at this point during the second hour of the experiment.

Sixteen naturally nephropathic dogs are included in the second group of animals. Eight of these animals received intravenously 5 c.c. per kilogram of a $n/2$ solution of hydrochloric acid, while the remaining animals of the group received by the same method of administration 25 c.c. per kilogram of a three per cent. solution of sodium bicarbonate. Following a half-hour period of anesthesia by ether, the reserve alkali of the blood of these naturally nephropathic animals was found to vary between 8.0 to 8.1; a variation similar to that obtained for the normal control animals.

When a naturally nephropathic animal is given 5 c.c. per kilogram of a $n/2$ solution of hydrochloric acid there occurs a rapid and marked reduction in the alkali reserve of the blood which is in excess of the reduction obtained in normal animals. In Experiment 14, which is representative of this group, there occurred within fifteen minutes after the introduction of the acid solution a depletion of the blood in its alkali reserve from the normal of 8.1 to 7.7. At the termination of the second fifteen minute period the reading remained unchanged, 7.7. No demonstrable attempt had been made on the part of the naturally nephropathic animal to reestablish a normal acid-base equilibrium. At the end of the first hour of the experiment the alkali reserve had increased to 7.85, and remained at this point during the final and second hour of the experiment.

The response of naturally nephropathic animals to a solution of hydrochloric acid differs quantitatively from the response of normal animals. The reduction in the alkali reserve of the blood is uniformly greater in a naturally nephropathic animal than it is in a normal animal. Furthermore, the normal animal is able to reestablish its acid-base equilibrium to a point within the range of the normal, while the naturally nephropathic animal is unable to effect such a return in the alkali reserve of the blood.

The eight naturally nephropathic animals that received intravenously a solution of sodium bicarbonate have shown the same type of reaction. The response of the animal of Experiment 21 is typical for this group. The animal had a normal alkali reserve of the blood of 8.0. Within the first fifteen minutes following the injection of the bicarbonate solution the reserve alkali of the blood rose to 8.4. At the end of the second fifteen minutes of the experiment the reading remained unchanged. At the end of the first hour the reserve alkali had been reduced to 8.2 and by the end of the second hour of the experiment to 8.15, a determination in excess of the normal reading of 8.0.

When the response of these naturally

nephropathic animals to a solution of sodium bicarbonate is compared with the response of the normal animals, the following differences are observed. The introduction of the solution into a naturally nephropathic animal effects a more marked disturbance of the acid-base equilibrium of the blood, as is shown by a greater increase in the alkali reserve, than occurs in a normal animal. When such a change is induced in the blood of a normal animal there occurs a rapid depletion of the reserve alkali of the blood with a return of the blood to its normal acid-base equilibrium. When, however, a similar type of change has been induced in the blood of a naturally nephropathic animal, the animal appears unable to effect with the same rapidity and degree of completeness a reduction in the reserve alkali of the blood with the reestablishment of a normal acid-base equilibrium. The reduction in the alkali reserve in such an animal takes place more gradually, and at the end of a two-hour period of observation the alkali reserve remains at a higher point than was obtained for the normal reading.

The experiments indicate that the reserve alkali of the blood in certain naturally nephropathic animals may be maintained by the animal within the range of normality. Such an observation is, however, no index of the ability of such an animal to maintain a normal acid-base equilibrium of the blood when the stability of the mechanism which regulates this equilibrium is subjected to the strain of handling either an acid or an alkali. When a normal animal receives intravenously an acid or an alkaline solution there occurs a disturbance in the acid-base equilibrium of the blood which is temporary, and which is rapidly followed by a reestablishment of the animal's normal acid-base equilibrium. When a naturally nephropathic animal is subjected to a similar disturbance in the acid-base equilibrium of its blood, the lack of stability on the part of the mechanism which maintains this equilibrium is shown by the facts that the acid or alkaline solution induces a greater degree of variation from the animal's normal equilibrium and that the animal is unable to reestablish within the time limit allowed the normal animal a return of the blood to a normal acid-base equilibrium.

Wm. DeB. MacNider
University of North Carolina

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

Wm. D. Harkins, *chairman*

H. N. Holmes, *secretary*

Preparation of zinc nitride: W. J. Bently and Paul L. Stern. After the trial of several methods of making zinc nitride the following was found to be the best. Ammonia was passed over zinc dust for 30 minutes at 650° C. and the product cooled to at least 200° C. before exposure to the air. The ammonia was treated to remove oxygen and moisture. The zinc dust was washed with a solution of ammonia and ammonium chloride, alcohol and ether. It was then dried in vacuo. The chief difficulty was in excluding oxygen from the system. The highest yield was 36.8 per cent. nitride. Alloys of zinc-zinc nitride were prepared up to 3.9 per cent. nitride. It is thought a thorough investigation will disclose many valuable properties.

Hydrolysis of the calcium phosphates: H. V. Tarter.

On the hydrolysis of the silicates of sodium: Robert Herman Bogue.[1] A series of seven silicates of sodium have been examined in which the ratio of Na_2O to SiO_2 in the molecule varied from 1: 1 to 1: 4. Solutions of each were made at five different molecular concentrations, and examined electrometrically for their hydroxyl-ion concentrations. From these values the degrees of hydrolytic dissociation have been calculated. Agreement with earlier investigations was not attained, and hypotheses are presented to account for this disparity. The values obtained for hydrolytic dissociation are much lower than have been previously reported. As the percentage of Na_2O in the molecule increases, the resulting product becomes less stable, and in dilute solutions ever increasingly hydrolyzed.

A revision of the atomic weight of antimony: H. H. Willard and R. K. McAlpine. Final report on the analysis of the tribromide.

On the separation of crystalloids from one another by dialysis: Louis Kahlenberg. Using pyridine

[1] Industrial Fellow Mellon Institute of Industrial Research, Pittsburgh, Penna.

as the solvent and vulcanized rubber membranes as the septa, the members of the following pairs were separated from each other by dialysis: (1) cane sugar and sulphur; (2) silver nitrate and naphthalene; (3) silver nitrate and camphor; (4) silver nitrate and sulphur; (5) cane sugar and camphor; (6) cane sugar and naphthalene; (7) lithium chloride and sulphur; (8) lithium chloride and camphor; (9) lithium chloride and naphthalene. In the case of each pair, the last named substance passed through the membrane and the first named remained behind in the solution in the dialyser. The results are entirely in harmony with the author's views on osmosis as expressed in a previous paper, *Jour. Phys. Chem.*, 10, 141 (1906), and in fact the results obtained were predicted by the principles laid down in that paper. The work is being continued. Not only have crystalloids been separated from each other by dialysis, but colloids have also been thus separated from each other, and colloids have been separated from crystalloids *by having the colloids pass through the membrane* and crystalloids remain behind in the solution in the dialyser. These results too are in perfect accord with the principles of osmosis as expressed by the author in his previous publication (l. c.).

Investigations on gelatines. Decay of viscosity on hydrolysis as a function of hydrogen ion concentration: S. E. Sheppard, Felix A. Elliott, Harry D. Gideonse and (Miss) C. M. Godden.

Investigations on gelatines. Protein errors of indictors: (Miss) A. J. Benedict and Felix A. Elliott.

Gelatine as an emulsifying agent: Harry N. Holmes and W. C. Childs. Using gelatine as a typical hydrated colloid excellent emulsions of kerosene-in-water were made and their stability observed. It was found that the leading factor as regards stability was a definite and most favorable viscosity, no matter how obtained. This viscosity could be secured by using the required concentration of gelatine, or with more gelatine made less viscous by such peptizing salts as sodium iodide, or with less gelatine made more viscous by coagulating salts of the sodium sulfate type. Lowering of surface tension was a factor of somewhat less importance. There was no evidence within the limits of accuracy employed of the formation of adsorption films at the oil-water interface. There must have been such adsorption but it was evidently too limited in amount to play a leading part in emulsification.

Adsorption of precipitates III: The adsorption of precipitating ions by hydrous aluminum oxide: Harry B. Weiser and Edmund B. Middleton.

The thermal decomposition of gaseous nitrogen pentoxide. A mono-molecular reaction: Farrington Daniels and Elmer Johnston. (Lantern.)

The structure of gold amalgams: S. A. Braley and R. F. Schneider. (Lantern.)

Some new methods for determining the vapor pressure of hydrated salts: Robert E. Wilson. (Lantern.)

Measuring low vapor pressures: Alan W. C. Menzies.

Adsorption of gases by nickel catalyst and the mechanism of hydrogenation: H. S. Taylor and A. W. Gauger.

A new form of titration hydrogen electrode: Felix A. Elliott and S. F. Acree.

Electrometric standardizing of permanganate and dichromate with hydriodic acid, and the "super-oxidizing power" of dichromate: W. S. Hendrixson. Potassium iodide, free from other halogens and standardized with silver, was titrated electrometrically in normal sulfuric acid with permanganate standardized with sodium oxalate. Known solutions of potassium dichromate were treated with twice their equivalent of potassium iodide, and the excess of the latter titrated with permanganate. The dichromates were true to theory, showing no "super-oxidizing power," contrary to J. Wagner and others and in agreement with G. Bruhns and others. The use of hydriodic acid as a standard in oxidimetry, practical applications and interferences will be further studied.

The isotopes of lithium as related to the constitution of the nuclei of atoms: W. D. Harkins. (Lantern.)

The distribution of strong electrolyte between benzene and water: Arthur E. Hill.

The cryoscopy of boron trifluoride solutions: system with hydrogen sulfide: A. F. O. Germann and H. S. Booth.

The dielectric constant of selenium oxychloride: James E. Wildish.

Ion conductance of strong electrolytes: D. A. McInnes.

The independent origin of acrinium: Elliott Q. Adams.

Nephelometric estimation of sulfur and barium: Lloyd K. Riggs and C. Walter Eberlein.

Further studies on the freezing points of the nitrotoluenes: J. M. Bell, E. B. Cordon, F. H. Spry and W. White.

The system water-benzene-silver perchlorate: ARTHUR E. HILL.

The cryoscopy of boron trifluoride solutions: System with phosgene: A. F. O. GERMANN and VERNON JERSEY. (Lantern.)

III. The cryoscopy of boron trifluoride solutions: Systems with sulfur dioxide and with nitric oxide: A. F. O. GERMANN and WENDELL PHILLIPS. (Lantern.)

The cryoscopy of boron trifluoride solutions: System with hydrogen chloride: A. F. O. GERMANN and LELAND R. SMITH. (Lantern.)

Conductance corrections and ionic mobilities from hydrated ion concentration measurements: FELIX A. ELLIOTT and S. F. ACREE.

Contact potentials in hydrogen ion determinations: (MISS) A. D. DUSHAK, FELIX A. ELLIOTT and S. F. ACREE.

Titration curves of some new buffer mixtures: (MISS) A. D. DUSHAK, FELIX A. ELLIOTT and S. F. ACREE.

Investigations on gelatines. The Gold Number: S. E. SHEPPARD and FELIX A. ELLIOTT.

The hydrogenation of benzene: H. S. TAYLOR and G. DOUGHERTY.

Period of induction preceding changes of hydration in the hydrates of cupric sulfate: NATHANIEL H. FURMAN and ALAN W. C. MENZIES.

Certain physical properties of three oils: ALAN W. C. MENZIES.

The oxidation and luminescence of phosphorus I: The behavior of phosphorus in pure oxygen: HARRY B. WEISER and ALLEN GARRISON.

The photochemical decomposition of gaseous nitrogen pentoxide: FARRINGTON DANIELS and ELMER JOHNSTON. (Lantern.)

An improved method for the preparation of cuprous chloride and cuprous bromide: HENRY C. WATERMAN and CURTIS M. PARKHURST. (By title.)

"Radiation as factor in chemical action": IRVING LANGMUIR.

"The crystal structure of ice": D. M. DENNISON and IRVING LANGMUIR.

DIVISION OF CHEMISTRY OF MEDICINAL PRODUCTS

Charles E. Caspari, *chairman*

Edgar B. Carter, *secretary*

A new organic arsenical and related compounds: C. S. LEONARD[1] and EDWARD KREMERS. Preliminary experiments on the chemistry of the heptane solution having revealed the readiness with which the halides of the elements of the fifth and fourth groups react with organic bases, the piperidine derivatives of arsenic, antimony, silicon, and tin were prepared. The reaction with arsenic trichloride may be indicated in the following manner:

$$AsCl_3 + C_5H_{10}NH \rightarrow As(C_5H_{10}N)_3As \cdot 3HCl.$$

A preliminary pharmacological investigation of the arsenic compound has been made by C. S. Leonard and Julia Whelan in the laboratory of Professor Loewenhart. Compounds with other bases, also with other halides, have been prepared in the test tube, but have not yet been obtained in sufficient quantity and of desired purity for analysis and further study. The continuation of this line of research is contemplated. In another direction, a secondary hexyl derivative of piperidine has been prepared to test out a recent theory concerning the length of the chain in local anaesthetics. The preparation of the corresponding heptyl product is under way.

[1] Newport Chemical Company Fellow.

Available chlorine for disinfectant bath: L. E. SAYRE. Experiments with different formulæ solutions of hypochlorite, acting upon resistant micro-organisms, to ascertain what kind of solution produces the maximum efficiency. Experiments performed to meet a demand of the Board of Health of Kansas.

On the rate of evaporation of ethyl chloride from oils: CHARLES BASKERVILLE and MYRON HIRSH.

Experiences with and new applications of oil-ether in anesthesia: CHARLES BASKERVILLE.

Some recent anesthetics: E. H. VOLWILER. Within the last year some local anesthetics have been produced to replace cocain for surface anesthesia. They are the gamma di-n-butylamino-propyl alcohol ester and the gamma diallylamino-propyl alcohol ester, respectively, of p-aminobenzoic acid. The latter is only two fifths as toxic as cocain and more than twice as effective on the rabbit's cornea. Two new local anesthetics of the anesthesin type are the n-butyl and the allyl esters of p-aminobenzoic acid. The former gives anesthesia of long duration, the latter very rapid anesthesia. This work has been done by the research staff of the Abbott Laboratories.

The origin and biological significance of the diastases: HUGH A. MCGUIGAN. A general study of diastatic activity has been undertaken in the attempt to determine the origin and significance of the diastases. From this work and previous work,

the following facts are obvious: All cell tissues contain diastase. The more vigorous and active the tissue the greater the diastase content. Diastase is formed in greater quantity, perhaps entirely, in the anabolic or growing state. This anabolic state persists to some extent as long as the tissue lives, and while not manifest by an increase in size, is manifest in the repair of tissues exhausted by the basal metabolism. In conditions of great waste, *i.e.*, excessive katabolism, there is a decrease in diastase content. The method used for the determination of the diastatic content of the tissues is described in the *Journal of Biological Chemistry*, 1919, Vol. 39, p. 274. The order of diastatic activity of the dog and rabbit was given. The tissues of other animals show a close agreement with this test. The effect of the state of health on the diastatic content of the blood of human patients suffering from cancer, pernicious anemia and typhoid was compared with the diastatic content of normal blood. In all cases the content was lower in the diseased state. This is in agreement with what has been found on plants which contain more diastase in the healthy vigorous state. The suggestion is made tentatively that the diastase content of a tissue may be used as a measure of its functional activity, and perhaps also as a test of basal metabolism. While the work is unfinished it would seem that diastatic activity runs parallel with functional activity; the more active the tissue the greater its diastatic activity and the significance of the diastases is that of life itself. There is no indication that diastase is a waste product as has been assumed by some investigators.

New benzyl esters possessing anti-spasmodic action: H. A. Shonle and P. Q. Row. In investigating the anti-spasmodic action of the benzyl nucleus the benzyl esters of lauric, myristic, palmitic, stearic, and oleic acids were prepared. They are either liquid or low melting solids, insoluble in water and practically tasteless and odorless. They are hydrolyzed as readily as olive oil when acted on by lipase in vitro. They possess no irritating effect on the mucous membrane, and in clinical cases cause the relaxation of smooth muscle.

Benzyl succinate: Mortimer Bye. Following in the footsteps of Macht, of Johns Hopkins, and appreciating the many objectionable features in the administration of benzyl benzoate, the writer was led to seek for some *solid* material which would be more suitable for medication and more palatable to take. Benzyl succinate seemed to offer a solution of this problem, and accordingly the product was prepared, following modifications of the method of Bischoff & Von Hedenstrom (*Ber.*, 35, 4079) in which succinic acid and benzyl alcohol in molecular proportions are heated on an oil or metal bath for several hours at 180°–190°; after cooling and filtering the filtrate is subjected to vacuum distillation on a metal bath. The benzyl succinate distilling over at 235°–245° C. at 15 mm. pressure, crystallizes on cooling and is purified with solutions such as alcohol, ether or chloroform. The product is a beautiful snow white crystal, practically with very little odor or taste and practically non-toxic. Judging from our own experience and by the work of other investigators, benzyl succinate should be applicable to the treatment of all "diseases" wherein the use of benzyl benzoate is indicated. Such uses will be given in greater detail in the main paper.

Benzyl derivatives of salicylic acid: E. A. Wildman. It has seemed desirable to investigate the various types of compounds containing the benzyl radical in other types of linkage than esters. The benzyl ether of salicylic acid has been shown to possess distinct physiological activity.

Some new compounds of phenylcinchoninic acid: H. W. Rhodehamel and E. H. Stuart. Phenylcinchoninic acid (2 phenyl-quinoline-4-carboxylic acid) combines readily with halogens and forms stable compounds with well characterized properties. A hydrochloride, hydroiodide, hydrobromide and hydrofluoride are described. Phenylcinchoninic acid also combines readily with quinine to form quinine phenylcinchoninate. This compound occurs as a white crystalline, nearly tasteless body, insoluble in water, but soluble in alcohol and acetone.

Charles L. Parsons,
Secretary

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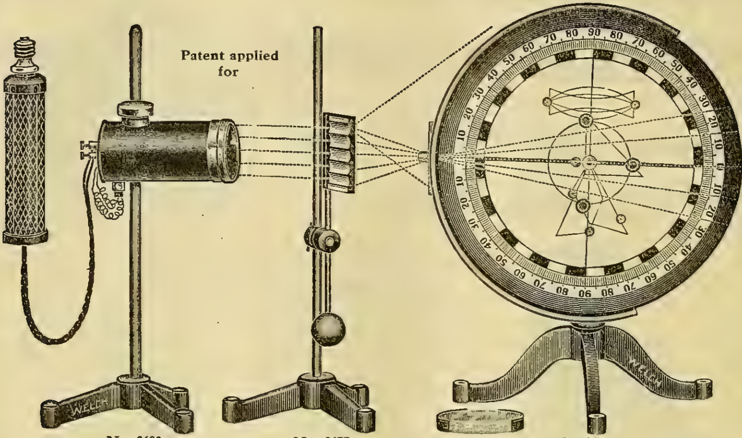

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SCIENCE

FRIDAY, FEBRUARY 18, 1921

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PRACTICAL VALUE OF ANTHROPOLOGY TO OUR NATION[1]

THE last few years have taught American scientists the lesson of service to our nation in time of crisis. It had seemed to be a condition of our American civilization that the vast bulk of our people spent their energies solely on their private interests. Most of these private interests were producing things demanded and sold in the market, hence were esteemed at all times of practical value. A science which did not benefit commodities hawked and sold in the public market was given only scant passing notice. This condition has had much to do with the slowness of certain sciences in developing their practical phases. But in our time of national peril it was demanded of every science that to the utmost limit of its practical possibilities it be useful to the state. So great was the impetus given to the development of the practical side of scientific research that in pragmatic America of this hour a science which can not develop its practical side of service to its nation and to its day can not long retain respect among other sciences.

It is probably true, as Earl Gray said, that nationalistic statesmen are largely opportunists who see only a little way ahead, and who are entitled to congratulate themselves if they steer their powerful nations safely among the rocks and bars which appear unexpectedly in the uncharted course along which they sail. A long look at nations as they have come and gone reveals the tragedies of the opportunist statesmen. In modern times the nations of the old world seem to have had their courses quite largely projected into the future by the inevitable continuity of a long historic past. Yet we now see their statesmen too were largely

[1] Address by the vice-president and chairman of Section H (Anthropology), of the American Association for the Advancement of Science, at Chicago, December 28, 1920.

only opportunists; they could not foretell the future. Since this is true, can Americans easily overstress the need our nation has of all data obtainable to assist her along her course so infinitely new?

I have no hesitation in saying that of America's recognized problems those most unique, and most difficult to foresee in solution are anthropological at base. Because of these problems confronting America our anthropologists have the opportunity and the duty of service to our nation second to no other group of scientists. I put them first.

Psychologists have given us the scientific procedure for thinking through great problems: *First,* there must be a clear statement of the problem; *second,* the accumulation of all obtainable data; *third,* a survey of the accumulated data with all possible judgment and guided imagination, resulting in conclusions which, after constant efforts at refutation and verification, should furnish grounds for future action. I fear that we as anthropologists have sometimes stopped at the second point without going on to the most vital part of the procedure covered by the third. A step further than this is necessary, however. In a nation with government by public opinion and universal franchise any conclusions which are to affect national policies and actions must be so popularized that an educated public opinion will irresistibly dominate the nation in questions affected by these conclusions. Public opinion so engendered concerning anthropological questions would put their solution in the scientific class—that of deliberative thought and action. It would take their solution out of the disreputable but still existing class of chance or luck; and out of the still more common but extremely wasteful class of trial and error. From anthropologists should come the data, as far as possible the conclusions, and to a certain extent the programs for the solutions of our national problems which have an anthropological basis.

We shall not have time in one brief paper to state all the anthropological problems whose solution would be of practical value to our nation. I wish to touch in a general way on the fundamental value to our nation of practical anthropological research as a whole and then to pass on to a more extended discussion of the relation of anthropology to two of the gravest problems before the nation to-day.

Stated broadly the bed-rock national anthropological problem is the survival and improvement of the human element of our nation. The *sine qua non* of civilization at any time is man's survival on physical, intellectual, and moral planes as high as those he possessed at that time. Civilization is lost to the extent that man's survival-planes are lowered. The goal of civilization seems to be for increasing numbers of mankind to survive on more elevated planes of mutual physical, intellectual and moral freedom. It appears to be a part of cosmic evolution for each generation to press toward that goal. But to a large extent even to-day our generation is pressing blindly toward this goal with its mind on remedial factors rather than on causative factors. There is a pertinent question and its answer in Ellsworth Huntington's new book, "World-Power and Evolution":

> Shall we despair because the church, the school, the charity organization, and the state have not yet destroyed war, pestilence, lust, greed, cruelty and selfishness? Far from it. These agencies can not possibly play their proper parts unless science comes to their aid.

The time has come when anthropologists who study breeds of men from the disinterested scientific point of view should help create dominating constructive public opinion founded on research to assist our nation toward her goal of developing civilization.

In my "Report on the Science of Anthropology in the Western Hemisphere and the Pacific Islands," published by the Carnegie Institution of Washington in 1914, I discussed this question at some length under the section with the general title of "Modern Problems" and the sub-titles of "Ethnic Heredity," "Influence of Environment on Mankind," "Human Amalgamation," and "An Anthropological Laboratory." I here quote from the opening and closing paragraphs of that section of the "Report":

It must not be supposed that the anthropologist is limited in his interest and his field of work to man's evolution of the past. He knows man is still in the making. He studies man's present-day evolution in its individual and ethnic aspects. He makes his studies of both the past and the present, with an eye to the future, in order that those things which vitiated or benefited the evolutionary process in the past, and which vitiate or benefit it to-day, may serve as guides for future generations.

The field of anthropological study of modern people is new and unoccupied, only the barest beginnings having been made. The horizon of this coming field for research among present and future man and ethnic groups is seen to extend indefinitely into the future. It would be difficult to overestimate the practical value of these continued studies. Their utility would be world-wide.[2]

A permanent laboratory should eventually be established in connection with these studies in ethnic heredity, environment, and amalgamation where records of research would continually accumulate and where they would be kept indefinitely. From this laboratory new data should be published frequently, not alone for conclusions which might have been arrived at, but that such data might assist investigators in various parts of the world. . . .

It may be argued that, even were the facts of heredity, environment, and amalgamation obtained and available, they would be of little use to-day, since influences are already at work which would be impossible to control. To a certain extent this is true, but one of the essentials of human progress is that man works not for his own generation alone, but for future generations. One can not measure the beneficial results to future generations of a body of accurate and scientific facts available on these subjects. Moreover, facts of this kind to-day in America become a part of educated public opinion surprisingly soon, and have their inevitable and far-reaching influences.[3]

The president of the Anthropological Section of the British Association for the Advancement of Science in his recent address at Cardiff emphasizes in no uncertain terms the necessity of making anthropological research of service to the nation, and urges the establishment of "anthropological institutes" in British universities to further this end.[4]

There can be no question of the service anthropological knowledge and research might render to the United States to-day.

In the improvement of plants and animals in the economic life of the United States our experts are constantly at work using as their ready tools every latest fact of scientific knowledge. We have carefully studied, selected and improved the native American maize, potatoes, yams, tobacco and turkey, and built them into our everyday life.

The United States government keeps in constant employ experts who in recent years have imported many varieties of plants and animals which are successfully and permanently built into our economic production.

Among such plants, I quote from a personal letter received from Dr. Fairchild, Agricultural Explorer in Charge, United States Department of Agriculture, Bureau of Plant Industry, Washington, D. C., "are the durum wheat brought since 1898 from Russia with now an annual value in increased wealth to the farmers of the United States of $50,000,000, the Sudan grass imported in 1909 from the Sudan with a crop in 1918 valued at more than $10,000,000, the Rhodes grass from Rhodesia, represented now by an industry of several millions, the feterita from the Sudan, which since 1906 has grown to an industry of over $16,000,000 annual value, the Egyptian long staple cotton, which since 1899 has become an industry worth over $20,000,000 in southern California, the soy bean crop, which to-day amounts to six and one third million dollars, and the newer things, such as the avocado, the dasheen, the chayote, the Chinese jujube, the Oriental persimmon, the Japanese bamboo, the tropical papaya, the Japanese rices, which cover now 60,000 acres of land in California alone."

To this list must be added the date brought from the Sahara or the deserts of Arabia. It

[2] Page 54 of "Reports upon the Condition and Future Needs of the Science of Anthropology," presented by W. H. R. Rivers, A. E. Jenks, and S. G. Morley, at the request of the Carnegie Institution of Washington, printed 1914.

[3] Page 58, *ibid.*

[4] "Institutes of Anthropology," by Professor Karl Pearson, in Science, October 22, 1920.

was estimated in 1919 that there were 200 acres of date palms already established in the Coachella and Imperial Valleys of California. Concerning this industry Dr. Fairchild says not only have our experts "been instrumental in building up this industry, but their study of the methods of propagation, the diseases and methods of their control, the insect pests and the requirements of the date palm constitute the largest collection of exact data now in existence in regard to this industry, and the Old World has had to come to America for the latest information in regard to this industry. Too great emphasis can not be placed upon this accomplishment and the manner in which he [Mr. Swingle] has brought it about. It represents in my mind one of the most remarkable pieces of agricultural work which has been done in recent times."

Among the recent most successful animals imported into the United States are the Aberdeen-Angus cattle, the Herefords, and the Belgian draft horses. Among the Hereford cattle, solely since 1901, America has developed a polled or hornless variety which has added another virtue—that of early maturity, thus producing "baby beef."[5]

Thus through national, state, county and private expenditure of millions of dollars annually, we now have as integral parts of our economic life scores of plants and animals which were alien importations only a few years ago. Over extensive areas there is so much of common knowledge about these plants and animals that as public opinion it dictates common policies and practises.

Shift the picture just a little. While we carefully nurtured many of our native plants, the native Indians who were here so long that they had become a distinct breed of mankind, and who in thousands of years of adjustment to American conditions had fitted American environmental areas better than did their plants, we either slew, or as remnants segregated as enforced dependents, not only robbing them of their native life which had developed their own peculiar strengths, and preventing them from building into the common life of America, but condemning them to sure deterioration. A scientific study of the American Indians as the men who had adjusted themselves to American environments for thousands of years would have been reasonable. What elements of strength, resistance or immunization had those men developed to have so long withstood the varied harshness of our American environment? Perhaps these qualities may be seen to be the prerequisites of permanent survival in America. The American plant breeder has long made use of hardy native plants to make his more prolific hybrids more resistent to cold, drought, disease and insect pest. Had we been as intelligent in the matter of the Indians as we have been with plants and animals there is little question that conditions would have been better for the Indians, and they might have added desirable strength to our nation.

Again shift the picture. While we have imported so many plants and animals, and with scientific knowledge and care have built them into our common life, there have been coming to our shores, of their own volition, peoples from over the earth of many breeds and many cultures who have distributed themselves here in many different environmental areas. In striking contrast with our state of knowledge about imported plants and animals we possess almost no scientific knowledge about these peoples such that it has become public opinion even among educated persons—to say nothing about its dictating nation-wide policies and practises.

I wish to state again as I stated in 1914, but with added emphasis, the imperative need in America of scientific research among modern peoples along the lines of ethnic heredity, environmental influences, amalgamation and assimilation, and the need of laboratories to further this research and conserve its results. That we to-day should have abundant laboratories for practically every science except anthropology, and ignore the richness of the

[5] Personal letter from George M. Rommel, chief, Animal Husbandry Division, U. S. Department of Agriculture, Washington, D. C.

materials in our midst for anthropological studies of practical value to our nation is a mistake whose consequences will be far-reaching in their disaster. "Legislation which ignores the facts of variation and heredity must ultimately lead to national deterioration," said the British birth-rate commission in 1917.[6] Every day henceforth in the life of the American nation anthropological data should be recorded just as our Treasury Department daily keeps its fingers on the financial pulse of the nation. In leaving this point I quote as a pertinent scientific fact of to-day a sentence from Pearson's recent address at Cardiff above referred to: "The future lies with the nation that most truly plans for the future, that studies most accurately the factors which will improve the racial qualities of future generations either physically or mentally."[7]

We come now to the first of the two problems vital to America which we wish especially to consider.

Mr. Frederick A. Wallis, Immigration Commissioner at the port of New York, recently said that the greatest problem before America to-day is the Immigration Problem. The whole nation is coming to a realization of the truth of this statement. The seriousness of the problem is equalled only by our lack of data, our lack of methods and technique, our general ignorance in dealing with it. Ferrero, the Italian historian, recently said:

> My first surprise [on coming to the United States], and a very great one it was, arose from my examination at close quarters, of the policy pursued by the United States in dealing with the immense hordes of immigrants, who yearly pour into their harbors from all parts of the Old World.

This question was of especial interest, as he said, "to a historian of Rome, like myself, to whom history has taught the great internal difficulties which were caused in every ancient state by the *metoipoi* or *peregrini* [*i.e.*, aliens]."[8] This great problem of the admission, the distribution, and the assimilation of the immigrant in America is at base anthropological.

Ethnic groups differ one from another. It is commonly supposed to be true that their differences are only "skin deep," but you and I know that ethnic groups differ beneath the skin. We know that the processes of pigment metabolism are so unerring and persistent that patches of skin taken from one person and grafted on another take on the proportion of pigmentation natural to the "stock" or seat on which the transplanted skin lives. We know also that ethnic differences are so much more than only "skin deep" that ovaries transplanted from one person to another person would reproduce children of their own kind without influence by the person who served as "stock" or seat for the transplanted ovaries. There are no experiments of this sort known to me, but what has been proved true with other animals would without question be true of human animals. Thus there is scientific reason to speak of different "breeds" of people whose differing physical characteristics are to-day due to the factors of heredity resident in the reproductive germ cells. Ethnic differences are not simply "skin deep." They are germinal. They begin at the functional innermost center of the person, and they continue through to the outside. The man who runs sees the outside differences between breeds of people. The anthropologist knows they begin inside in the seeds of the breeds.

Out of the physical man grows the psychic man. As out of these different physical characteristics of the different breeds of people come the psychic characteristics of those breeds of people, it should be expected that the reactions of the different breeds of people would exhibit differences. The practical handler of peoples knows such is the case—whether he is an administrator of colonies, a policeman in any large cosmopolitan city, or boss of a gang of mixed "foreigners" on any American railway job. At the present moment

8 Pages 139–140, Guglielmo Ferrero, "Ancient Rome and Modern America," 1914.

6 Page 45, "The Declining Birth-rate by the National Birth-rate Commission," London, 1917.

7 Page 376, "Institutes of Anthropology," by Professor Karl Pearson, Science, October 22, 1920.

it can not be said that these differing reactions of the different breeds of men are due to physical differences or to psychic differences or to social and cultural differences, or to something yet unnamed. All that is known is that different breeds of people commonly possess distinguishing reactions in many of the affairs of life.

The American immigration problem is centered in the various breeds of people who are clamoring to come to our shores or who are already in our midst. What facts and tendencies of strength and weakness for the future of the American nation are in those various ethnic groups? On the answer to this question hinges the whole immigration problem. It is a question for the most careful study, the accumulation of accurate data, and for effort at scientific conclusions on the part of anthropologists in order that an intelligent public opinion based on known facts, instead of sentiment or prejudice or commercial profits for the few, may dictate our policies and practise in regard to the peoples coming to us or already here. Some peoples can, do, and will continue to build into the American plan of development. Others do not, and should not be expected so to develop without due education and often tedious application. Others probably never would. We must have a public opinion on this question based on scientific facts as to the relative assimilability of the various peoples already here, and also on the actual attitude of the leaders of the several groups toward the necessary American goal of rapid and complete assimilation. If further immigration is to be allowed or encouraged, the national policy should welcome those groups most favorable to assimilation, and should restrict those unfavorable to assimilation.

So also in the problem of the distribution of immigrants in America wise use should be made of anthropological data. Practically each one of the peoples coming to us from Europe has lived for many generations in one type of environment, in many cases has pursued one kind of employment, so it has developed rather fixed reactions which have saved it. The anthropologist should be able to put at the service of the nation such knowledge of European environments and peoples and of American environmental areas that the different immigrant peoples could be sent to, or educationally advised to go to, those areas and employments most likely to prove helpful rather than injurious to the immigrating generation.

Let me cite a few illustrations of immigrant distribution personally known to me. A group of well-to-do Holland-Dutch farmers was brought as entire families with some thousands of dollars each from the wet alluvial lands of Holland, and planted in the sand of a northern Minnesota county on farms previously selected for the colony. Those families did not know how to farm on land which leaches dry in a few hours after a light rain, and which in the hot growing period of July and August could profit by heavy rains every other day. In ten years' time the members of that colony of industrious and hopeful immigrants who came to us prosperous farmers are scattered, their accumulations wasted, and, disillusioned, they work for a wage where they can.

Between 1850 and 1860 a small group of Finns came from the copper mines of Sweden to northern Michigan to work in the Calumet and Hecla mines. Since that time, particularly since 1900, northern Michigan and especially northern Minnesota have attracted many Finns from Finland. I know well their homes in Minnesota. There they find as nearly as well may be an environment identical with that of Finland. It is a heavily glaciated area with ridges of drift strewn with immense bowlders. Glacial lakes, marshes and small streams are everywhere. The forest is "Canadian" and identical with that of Finland. Other peoples, even the Scandinavians, have passed by those rough lands with their ridges and marshes, which the Finns actually seek out. There they continue to settle, clear the forests and make small farms. They are productive immigrants, happy and successful in their own sort of familiar climate, forests, soil and country life. I know some of them who

are joyous on those farms after having lived some years in the hustle of our Twin Cities. The Finns found their own environment by accident.[9]

The German-Russians also by accident went to the open plains of the Dakotas, and there in areas so like their Russian farms they have become contented and many are wealthy farmers. The chief adjustment they had to make was to larger farms, and American citizenship and language. While around many of the extensive mines and plants of our fundamental industries the Slavic-Russians are struggling to adjust themselves from the open-air life of Russian farms to the intense breathless life of the industrial gang. Many of those Slavs have been as misplaced as were the Holland-Dutch. With expert care and study we put our imported plants and animals in the areas to which they are best adapted, but we allow the peoples coming to us to go where chance or material profit for the moment leads them.

The results of anthropological and environmental researches in Europe and America could be so popularized as to become important factors in the matter of immigrant distribution, and so assist in checking the growing and fatal disease of urbanization in America.

The problem of the assimilation of our immigrant peoples has become of such importance in the last few years that it has attracted nation-wide attention and started a nation-wide movement known as Americanization. It is in this field of national endeavor that anthropology has an opportunity for paramount service to our nation. I wish in discussing this point to bring to you not simply a theory of what might be done but to tell you what actually has been done along this line in the University of Minnesota. Two years ago I presented a paper before this section in Baltimore on the plan then recently passed at the University of Minnesota to attempt to make a practical application of the science of anthropology to the great Americanization problem about which the whole nation was so much concerned and yet at the same time about which it was so much bewildered as to practical methods of approach.

The Americanization Training Course has now been established at the University of Minnesota for more than two years. Its object is the training of Americanization leaders to hasten the assimilation of the various peoples in America toward the highest common standards and ideals of America practicable for that generation. The course is founded on our anthropology courses which have been developing in our university for fourteen years. Those courses consisted not only of the usual foundation courses on the development of man, races and culture, but of courses dealing with modern anthropological problems especially those of vital importance to our immigrant nation. They have dealt with the peoples who have come and who are coming to America as immigrants, and with the negroes who came as slaves. They also dealt with the resulting peoples in America due to amalgamation and adjustment, and those psychic results so essentially American that we called them "Americanisms." On the establishment of the training course these courses were emphasized and developed, and on top of them we developed professional courses on the technique, the method, and the organization of Americanization work, also technical courses on the principles of adult elementary education, the adult elementary learning process, and the adult elementary teaching process, and also such practical field courses as supervised work with foreign peoples in homes, residence communities, industrial plants, public schools, etc. There have been difficulties, since we were so largely in an untried field. Some of the courses of necessity were at first only experimental. Instructors had not always all the training we might have wished. But the contact with workers in the same field, especially as we have been able to bring them in during our summer sessions, when they have come as instructors and students from New York, California, and cen-

9 "The Finn in America," by Eugene Van Cleef. Reproduced from *Bulletin of The American Geographical Society*, 1918.

ters in our middle states, has given a splendid impetus to the development of the work to-day.

The practical value of modern anthropological knowledge can no longer be questioned by one who knows the practical work done by those who have gone out from the training course. We have sent our trained Americanization leaders into several different states and into many different positions, such as those of state directors, city directors, school directors, directors with Y. M. and Y. W. C. A., churches, women's clubs, and as teachers in schools, homes, communities and industries. The continuous demand for these trained leaders is greater than our supply, and a gratifying aspect of this demand is that it so often comes from centers where already some of our trained workers are. Our trained leaders are making good in this practical effort to hasten assimilation in America, not only because they are trained in the professional, technical and practical courses, but, more especially, because through their anthropological courses they are equipped to know the different necessary approaches to, and reaction of, the different breeds of peoples among whom they work. Their work is among peoples. They have been trained to know peoples. This training course is not yet fully manned or as complete as is desired due to the almost universal shortage of funds in higher education. We need especially research men in physical anthropology, amalgamation, and environmental influence, as well as experts in certain practical fields. In fact, there should develop a genuine laboratory of research and of practical application of anthropological knowledge. The time is coming quickly when this will be developed somewhere.

Not only is this work being done in the University of Minnesota but under the impetus of the Americanization movement many colleges and universities which before had no anthropology courses of any nature have recently been putting in courses on modern peoples, especially our immigrant peoples, and some have added various professional courses on technique and method. Not only are these anthropology courses of value in purely Americanization work, but it will come to be recognized more and more that with America's vast heterogeneous population her public school educators, her social workers, her police and correction agencies will have to make practical use of anthropological knowledge of the various peoples with whom they deal.

To sum up—the immigration problem which is of such dominant importance to-day is in all of its phases anthropological at base, and if we are to arrive at any correct solution of the questions of restriction, distribution and assimilation of the immigrant in America, use must be made of anthropological knowledge and data and research.

The second problem before our nation today which is at base anthropological which I wish to consider is the Negro problem. One person in ten in our nation is Negro. We know practically nothing of scientific anthropological value about the American Negro. Toward him there is more fierce race prejudice than toward any other people, yet probably no stronger ties of personal friendship exist between members of different races than exist between individual southern whites and southern Negroes. As to the relative intellectual capacity of the American Negro probably greater disagreement of opinion exists between white persons who think they know than about any other people. There is imperative need of scientific research and the accumulation of scientific data to help our nation in the solution of the Negro problem.

The careful student of our national affairs sees four great Negro movements setting in in America like deep-swelling tides.

The first is that of Negro segregation. A great natural segregation movement is taking place in at least three extensive areas in three southern states. Negroes flourish better than white people in those areas. The whites are decreasing and the Negroes increasing until they not only outnumber the whites, but outnumber them increasingly year by year. A similar natural segregation is taking place also in many of our large cities.

The national problem for us is what type of Negro and culture is being produced in the

areas of natural Negro segregation. As those areas to maintain men and culture of a fair level with the remainder of the nation, or will they be lowered so that a sort of cultural and physical quarantine would need to be maintained? Will those areas spread their inferiority out over their borders? Haiti and Liberia are contemporary examples of slackening Negro culture. We should study the tendencies of this movement in America—this unsought for, uninvited, unintended environmental segregation of the two peoples.

A second Negro movement is the present unprecedented acceleration of Negro migration from south to north. Ever since the Civil War the Negro has been a restless migrant, but during the past three years the migration has turned particularly away from the south, and one million or more Negroes have come directly from their old southern homes into our northern cities.

The south and the Negro mutually understand each other. The white south will tell you that it has no Negro "problem," because there is a perfectly understood procedure in all interrelations between individuals, or groups, of the two races. The north and the Negro are almost total strangers. If the Negroes become proportionately as numerous in the north as they are in the south, will the interrelations between the two peoples be similar to those now in the south where the public opinion and the practise of the white south is, as expressed to me by men in several different southern areas, just this—"The white man will run the south. Whether just or not, it is necessary." The recent northern race riots in East St. Louis, Omaha, Chicago and Duluth are, in this connection, suggestive.

The most accurate data should be at hand in regard to this northward migration, and daily research should be carried on in its many varying aspects. We need scientific facts to understand the tendencies of so unprecedented a movement.

In one aspect of this northward migration of Negroes decisive opinion should be uttered without further research, and that is the movement of alien Negroes into the United States—largely from the West Indies. Only those who are so uninformed as not to know we have a tragically serious Negro problem in America can, on any except selfish grounds, favor the admission of alien Negroes to America. Have we not wisdom and character enough to prevent the further aggravation of the problem by the admission of some 6,000 more such aliens yearly?

A third of these Negro movements is the amalgamation of the Negro and the white, and the consequent effacement of Negroes by their physical incorporation with the remainder of the nation's population.

The growth in the per cent. of mixed-bloods shows that an increasing per cent. of "Negroes" possess mates with white ancestry. Unless the tide turns the descendants of a very large per cent. of our present Negroes in time will be incorporated in the then American breed of men.

The migration of the Negro to our northern cities and the large per cent. of foreign-born whites in these cities greatly complicates this phase of the Negro question. The foreigner coming fresh to our shores almost entirely lacks the racial prejudice which is native to America. I was told in Cleveland last summer by a student of the problem there that in that city intermarriage between the Negroes and Italians is taking place at a rapid rate in the two chief Italian centers of residence.

A most careful and conclusive study of our people of Negro-white ancestry should be made that we may know how the wholesale absorption of our Negroes by our whites will affect the qualities of the nation as a whole. At no given era in history has one nation probably been inherently greatly superior or inferior to another in the same general stage of culture, yet some competing nations have gone down while others have advanced. Apparently very slight physical, intellectual or moral superiority is enough to give successful advantage, and very slight inferiority enough to result in disastrous disadvantage between two nations quite equally favored by environment. History has no truths to tell of the relative strength or weakness of a nation so largely

Negro as ours seems at present destined to become. If we are not to blunder on in the dark, it is well to learn what forecasts of the future can be made by asking scientific questions of the present.

The fourth Negro movement I shall note is that of growing political power due to developing race consciousness and purposeful organization for political action.

August 19, 1920, the newly elected president of the Universal Negro Improvement Association is quoted in the press as saying, "The day is not far distant when the Negro will be a power in politics." In the October, 1920, number of *The Journal of Negro History* an article by Norman B. Andrews entitled "The Negro in Politics," closes with these words:

> In several of the cities of the North there is such a large Negro population and so much appreciation among the Negroes of their political power that they are now launching a movement to nominate and elect members of their race to represent them in Congress. It is likely that this may soon be effected in Chicago, New York and Philadelphia.

The National Association for the Advancement of Colored People says that in 1913 it defeated bills in eleven states out of twelve which aimed to prevent Negro-white intermarriage.[10] When an organization in the interest of one race in America, a race which numbers one tenth of our total population, can control legislation in eleven out of twelve states as far separated as New York on the Atlantic and Washington on the Pacific, it is very evident that that race is rapidly becoming an important political factor in the life of our nation.

A few years ago one of the foremost administrators of research funds in the United States said the American Negroes could not be researched by his institution because they were a political factor in America. Is this not the all-sufficient reason why we should have all possible scientific data and knowledge concerning the Negro? The Negroes and whites in America have become too dynamic for national disaster longer to be trusted to adjust their differences mainly on the basis of race prejudice on the one hand, or unthoughtful sentimentality on the other.

I have endeavored to show in this paper that our nation should make large use of definite and specific anthropological knowledge to help insure her national development. I am as interested as any anthropologist in all research into the development of man. I am interested in the development of culture. I prize as one of my very richest experiences my intimate contacts with primitive peoples, but, as an American believing in America and her possibilities, I am to-day first of all anxious that anthropologists use their scientific knowledge to assist America in the solution of her momentous problems.

Albert Ernest Jenks
University of Minnesota

[10] Fourth Annual Report of the Board of Directors of the National Negro Protective Association.

A BRIEF HISTORICAL CONSIDERATION OF THE METRIC SYSTEM[1]

The World Metric Standardization Council wishes briefly to present to the Mathematical Association of America the desirability of enrolling actively in support of the adoption of the metric system in the United States. This organization is an advisory organization, unifying the efforts of all who are urging the adoption of the metric units of weights and measures throughout the United States, the British commonwealths and the world. There are no decimal dues, but contributions to the cause are welcome.

Whatever theoretical advantages a duodecimal or sixty system might have, the fact remains that man is ten-fingered and learns to count and reckon with these mechanical aids assisting in the process of computation, either consciously or unconsciously. Among civilizations reaching any high degree of culture, only two have carried to any extent any other than a decimal system The sixty system of the Babylonians and the twenty system of the

[1] Paper presented before the Mathematical Association of America, Chicago, Dec. 28, 1920.

Mayas of Yucatan are exceptions. However, even in these systems, the ten (or five) forms a subsidiary system, apparently developed first. The further important fact should be noted that with the development of these numerical systems, both these civilizations included their systems of weights and measures. We may even say that it appears probable that the system of weights and measures was first brought to the sixty system among the Babylonians, and weights and measures to the twenty system among the Mayans, and from this carried over to the number system. Note that this reduction took place in Babylon as much as four thousand years ago. These ancient civilizations found it necessary, then, to make their number systems conform to their systems of weights and measures, including time.

The first systematic treatise on decimal fractions was printed in 1585, first in Flemish and then in French, by Simon Stevin, of Bruges. This work is addressed to astronomers, surveyors, masters of money (of the mint), and to all merchants. Stevin says, of this work, that it treats of "something so simple, that it hardly merits the name of invention." He adds:

> We will speak freely of the great utility of this invention; I say great, much greater than I judge any of you will suspect, and this without at all exalting my own opinion. . . . For the astronomer knows, . . . the difficult multiplications and divisions which proceed from the progression with degrees, minutes, seconds and thirds . . . the surveyor, he will recognize the great benefit which the world would receive from this science, to avoid . . . the tiresome multiplications in Verges, feet and often inches, which are notably awkward, and often the cause of error. The same of the masters of the mint, merchants, and others. . . . But the more that these things mentioned are worth while, and the ways to achieve them more laborious, the greater still is this discovery *disme*, which removes all these difficulties. But how? It teaches (to tell much in one word) to compute easily, without fractions, all computations which are encountered in the affairs of human beings, in such a way that the four principles of arithmetic which are called addition, subtraction, multiplication and division, are able to achieve this end, causing also similar facility to those who use the casting-board (*jetons*). Now if by this means will be gained precious time; . . . if by this means labor, annoyance, error, damage and other accidents commonly joined with these computations, be avoided, then I submit this plan voluntarily to your judgment.

What can one add to these words of the first writer on the subject, and an independent discoverer of decimal fractions? All that Stevin says applies to-day, hardly with the change of a letter. The genius of Stevin is evident in the comprehensive grasp which he had of the universal application of decimal fractions to affairs. Much of the benefit of this invention is lost to us in America, because we persist in using non-decimal weights and measures.

Louis C. Karpinski
University of Michigan

SCIENTIFIC EVENTS

THE ANNUAL MEETING OF THE BOARD OF TRUSTEES OF THE AMERICAN MUSEUM OF NATURAL HISTORY

A report of the nature and scope of the past year's work of The American Museum of Natural History was made on the evening of February 7 by President Henry Fairfield Osborn, at the annual meeting of the board of trustees, which was held at the home of Dr. Walter B. James. The president regards the year 1920 as one of the greatest years in the history of the museum, inasmuch as the institution's educational value has for the first time been fully recognized by the present city administration, and gifts, collections and funds for expeditions presented to the museum represent a total of $500,000.

Commenting on the financial condition of the museum, it was announced that the year's work had been concluded without the necessity of requesting the trustees to make their usual personal contributions to supplement the budget. This was due to the enforcement of the most rigid economy and to the fact that the city authorities, after a searching investigation of its affairs, recognizing the importance of the institution as a vital and ever developing adjunct to the city's educational system, had increased the annual maintenance allowance by $150,000 over the appropriation

for 1919. Appreciation was also expressed for the generous response to requests for membership and for support of exploration work.

The popularity of the museum as an educational center was evidenced by the visits of 1,040,000 persons during the year.

Regarding the museum's work of cooperation with the public schools, it was reported that 1,180,000 students had made use of the nature study collections which are loaned, without cost, to the schools; that 88,000 pupils had attended the lectures in the museum provided so that they might visualize the subjects treated in their studies; that 1,650 blind children had "seen" the material selected for their use and attended special lectures; that 136,500 people had made use of the collections loaned to the public libraries; and that 116,500 slides had been distributed to public-school teachers to enable them to give illustrated talks on travel and natural history subjects to their pupils. A new line of contact with the schools has been developed through a series of background lectures, given by the museum staff to the city's teachers in training, designed to give the student teachers a greater fund of information and breadth of vision and to familiarize them with the museum material and the ways in which it can be used to supplement class-room work. As a further development of this cooperative work with the public-school system, the museum's department of health, at the request of the Board of Education, has prepared a set of twenty exhibits, each set including food models, composition blocks and charts, and constituting an aid to the instruction of school children in dietary hygiene.

EXPEDITIONS AND ACQUISITIONS OF THE AMERICAN MUSEUM

The field work of the year included several important expeditions. In September, an expedition financed by Mr. Harry Payne Whitney and headed by Mr. Rollo H. Beck, started on a five-years' investigation of the birds of Polynesia. This is the most important expedition ever sent into the field by the department of ornithology. Mr. George K. Chorrie collected birds in southern Ecuador, and Mr. Harry Watkins worked in Peru. Mr. H. E. Anthony collected mammals and vertebrate fossils in Jamaica and southern Ecuador. Mr. J. C. Bell obtained specimens and casts of sharks and rays at Cape Lookout, North Carolina. The department of anthropology continued excavations at the Aztec, New Mexico, ruin (which work was provided for by the Archer M. Huntington Fund), sent a party into the Grand Gulch region of Utah to explore cliff-dwellings, and began with the Bishop Museum of Honolulu a joint investigation of racial problems in Hawaii. Members of this department also represented the Museum in Honolulu at the First Pan-Pacific Scientific Congress, at which plans were made for future Polynesian exploration and investigation, in which the American Museum will participate. The department of geology made investigations in New York and Pennsylvania, Tennessee and Kentucky, Arizona, California and Hawaii, collecting in these regions being done by Curator E. O. Hovey, Associate Curator Chester A. Reeds, and Mr. E. J. Foyles. Messrs. Albert Thomson and George Olsen excavated large fossil vertebrates in Nebraska, for the department of vertebrate paleontology. Dr. Henry E. Crampton, curator of the department of invertebrate zoology, began an extended trip through the South Seas and the Far East. Dr. F. E. Lutz, associate curator of the same department, explored in Wyoming, Colorado, Idaho, Utah and Indiana, and Mr. F. E. Watson did field work in Jamaica. Mr. Paul Ruthling collected in Mexico and Mr. Elwood Johnson obtained specimens in Colombia for the department of herpetology. Through cooperation with the New York Zoological Society, under the supervision of Mr. C. William Beebe, collecting has been carried on for the museum in British Guiana at the Zoological Society's Tropical Research Station there.

Important new acquisitions made during the year, other than material secured by the expeditions just mentioned, included a large collection of paleolithic stone implements from Egypt, presented by August Heckscher;

a rich and varied collection of ethnological material secured by the Rev. H. B. Marx and presented by Mr. J. P. Morgan; a large archeological collection from Iroquois sites in New York state, received through bequest of Herbert M. Lloyd; a suite of 68 mineral specimens from France, presented by Professor Lacroix of Paris; minerals from Chili presented by Mr. H. F. Guggenheim, and from Bolivia, presented by Mr. H. C. Bellinger; a ball, 10 centimeters in diameter, carved from a flawless rock crystal and mounted on a bronze elephant of Hindu workmanship, presented by Messrs. Sidney and Victor Bevin; a Japanese topaz, cut egg-shape and covered with facets, weighing 1,463 carate, donated by Mr. M. L. Morgenthau; a collection of pearls and pearlaceous growths presented by Mr. George W. Korper; a collection of marine fishes from Peru; a number of Honolulu fishes; a collection of fresh water fishes from China; a series of paleolithic implements from North Africa, selected by the French archeologist, M. Henri Breuil, and purchased through the Morris K. Jesup Fund; 1,200 mammals from North China and Mongolia—the largest and most valuable collection the museum has ever received from Asia—secured by the Second Asiatic Expedition; and 3,378 specimens (the greater part of which represent species new to the museum's collections) collected by Rollo H. Beck in South America and the West Indies, and presented by Mr. Frederick F. Brewster. This last mentioned item is the most valuable gift the Department of Ornithology has ever received. The Hall of Geology has been reopened to the public, after extensive re-arrangement and improvement, which is not yet completed. The re-installation of the North Pacific Indian Hall was reported to be almost finished. Early in 1920, the American Museum purchased, through the Archer I. Huntington Fund, the pueblo ruin at Aztec, New Mexico, which it has been investigating for the last five years. It was announced last night that in due time this property as uncovered and partially restored by the museum will be presented to the United States to become a national monument and to be administered as a national park.

THE BIOLOGICAL FIELD STATION OF CORNELL UNIVERSITY

Partly by purchase and partly through the generosity of Mrs. Herman Bergholtz, Cornell University has acquired land for what Professor Needham characterizes as "the best biological field station in this country, if not in the world." The acquisition comprises nineteen and a half acres of land at the north end of the Bergholtz tract, north of Percy Field. It is bounded on the east by the Lake Road and on the west by Cayuga Street. In accordance with the specification of Mrs. Bergholtz that the money which her gift represents be used either for the endowment fund or that the land be developed and improved as the trustees should decide, it has been turned over to the College of Agriculture to be developed as an aquatic park and field station. Money for its development is already available from that appropriated by the legislature for the college building and improvement program. The gift will also be included in the endowment fund.

The waters of Indian Spring, which is included in the tract, will be used for trout ponds, and those of the lake will be used in other ponds and marshes where plants and animals may be studied in their native environment. An apiary and field station laboratory are planned, the latter to cost about $15,000. Because the area includes swamp, running water and high land, it is considered to be almost ideal for the purpose for which it will be used. Unlike the fresh water field stations along the Great Lakes, the weather conditions permit experimenters to work most of the year instead of only about six months.

Mayor Edwin C. Stewart, of Ithaca, has expressed the hope that the city may develop other land in the vicinity so that all of what is now waste land at the end of the lake may eventually be a park for public use.

AMERICAN FOUNDATION IN FRANCE FOR PREHISTORIC STUDIES

At a meeting of the governing board of the American Foundation in France for Prehis-

toric Studies, held at the Hotel Plaza, New York, on February 3, 1921, Professor George Grant MacCurdy was elected first director of the foundation. Dr. Charles Peabody is chairman of the board and for the present will also serve as treasurer of the foundation.

The year's work will open at La Quina (Charente) on July 1. After a stay of some three months at La Quina, there will be excursions in the Dordogne, the French Pyrénés and to the Grimaldi caves near Mentone. The winter term will be in Paris; and the work of the spring term will include excursions to the important Chellean and Acheulian stations of the Somme valley, to Neolithic sites of the Marne or other suitable locality, and to Brittany for a study of megalithic monuments.

Students may enroll for an entire year or for any part thereof. Those who contemplate entering for either the year or the first term, should communicate immediately with the director, at Yale University Museum, New Haven, Conn.; or with Dr. C. Peabody, Peabody Museum, Cambridge, Mass.

One foundation scholarship of the value of 2,000 francs is available for the first year. The special qualifications of the applicant, together with references, should accompany each application. The foundation is open to both men and women students. The address of the director after June 15 will be care of Guaranty Trust Company, Paris.

SCIENTIFIC NOTES AND NEWS

Dr. Frank Billings, Chicago, has been elected president of the next congress of American Physicians and Surgeons, which meets in Washington, May 2–3, 1922.

At the recent meeting of the Mathematical Association of America the following officers were elected: *President,* Professor G. A. Miller; *Vice-presidents,* Professor R. C. Archibald and Professor R. D. Carmichael.

Dr. George Ellery Hale, director of the Mount Wilson Solar Observatory, has been awarded the Actonian prize by the Royal Institution of Great Britain in recognition of his work on solar phenomena.

Professor Henry Fairfield Osborn has been elected one of the vice-presidents of the Eugenics Education Society, of which Major Leonard Darwin is the president. The American committee of the Second International Eugenics Congress extended a special invitation to Major Darwin to attend the congress, but learned by his letter of December 1, 1920, that his health will not permit him to come. Invitations have been extended to several British, French and Scandinavian authors and writers in subjects of genetics and eugenics.

Dr. Graham Lusk has been elected corresponding member of the Société de Biologie of Paris.

Mme. Marie Curie has been invited to visit the United States and expects to come in May. Committees of reception have been appointed, including in their membership leading men of science. It is planned to present to Mme. Curie a gram of radium.

Dr. Henry Norris Russell, professor of astronomy and director of the observatory at Princeton University, has been appointed a research associate of the Mount Wilson Observatory of the Carnegie Institution of Washington for the current year. Dr. Russell has gone to England to receive the gold medal of the Royal Astronomical Society which was recently awarded him in recognition of his work on the evolutionary classification of stars. He expects to return in March to undertake his work at the Mount Wilson Observatory.

Harlow Shapley, of the Mount Wilson Solar Observatory, has been appointed observer at the Harvard College Observatory. and will enter upon his new work in March or April.

Dr. Henry H. Robinson, of New Haven, has been appointed superintendent of the Connecticut Geological and Natural History Survey to succeed Professor H. E. Gregory. His address is Hopkins Hall, Yale University, New Haven, Conn.

The trustees of Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History at Honolulu, Hawaii, have appointed

as curator of collections Dr. Stanley C. Ball, professor of biology in the International Y. M. C. A. College, Springfield, Mass. Leaving Springfield in March Dr. Ball will visit museums in Albany, New York City, Philadelphia, Washington, Chicago and San Francisco, reaching Honolulu about May 1.

Dr. Ralph C. Rodgers, previously in charge of the work in the physics of photography, at Cornell University, has been appointed assistant secretary of the illuminating engineering society.

The board of trustees of the American Medical Association reelected the following members of the Council on Pharmacy and Chemistry: L. G. Rowntree, Rochester, Minn.; Torald Sollman, Cleveland, and Lafayette B. Mendel, New Haven; and to fill a vacancy occasioned by the resignation of Professor Henry Kraemer, Dr. Charles W. Edmunds, professor of therapeutics and materia medica, University of Michigan.

Professor Dexter S. Kimball, of Cornell University, represented the American Society of Mechanical Engineers and the federated American engineering societies at the annual convention of the Engineering Institute of Canada, at Toronto.

At the next meeting of the Canadian Research Council, to be held in Ottawa, February 19, an interim appointment of chairman will be made to succeed Dr. A. B. Macallum, who resigned to accept the chair of biochemistry in McGill University, Montreal. The appointment of a permanent chairman will depend on the action of the federal government.

Dr. Lynds Jones, of the department of zoology of Oberlin College, announces a special trip under the auspices of the summer school, through the northwest, terminating in the town of Mora, Washington, on the Pacific coast. A special study of insect, bird, plant and animal life will be made and attention will be given to topographical geology. The trip will probably be made by automobile and will be in the field for eight weeks.

Dr. L. O. Howard, chief of the Bureau of Entomology, retiring president of the American Association for the Advancement of Science, delivered an address on "How the government is fighting insects," before the Washington Academy of Sciences on February 17.

Dr. A. N. Richards, professor of pharmacology, University of Pensylvania, will deliver the seventh Harvey Society Lecture at the New York Academy of Medicine on Saturday evening, February 26. His subject will be "Kidney function."

Dr. George Thomas Stevens, of New York City, author of contributions to opthalmology and neurology, died on January 30 at the age of eighty-eight years.

Dr. Henry Harrington Janeway, of New York City, known for his work on cancer, attending surgeon to the Memorial Hospital, died on February 1, at the age of forty-seven years.

Professor Henry Matthew Stephens, since 1899 professor of biology in Dickinson College, died on February 5, aged fifty-four years.

Dr. Leopold Landau, professor of surgery at Berlin, died on December 28, 1920, at the age of seventy-two years.

A regular meeting of the American Physical Society will be held in Fayerweather Hall, Columbia University, New York, on Saturday, February 26, 1921. If the length of the program requires it, there will also be sessions on Friday, February 25. Other meetings for the current season are as follows: April 22–23, 1921, Washington; August 4, 5, 1921, Pacific Coast Section at Berkeley.

The Royal Agricultural College at Cirencester, the oldest place of agricultural instruction in the British Empire, is threatened with extinction at the end of the year unless a minimum capital sum of £25,000 can be raised by private munificence to save it. The college, which was founded seventy-five years ago under the patronage of the Prince Consort, has since 1915 been occupied by a girls' school from the east coast, whose tenancy ends at Christmas. The Ministry of Agricul-

ture are asking the governors to reopen the college for its originally intended purposes, and have promised, subject to certain conditions a small, annual grant towards its maintenance. The governors are anxious to take this course, they have considered and approved a curriculum of greater general utility and of a more practical character than that formerly pursued at the college, and have conditionally secured the services of a principal of exceptional qualifications. In an appeal issued on behalf of the governors, Lord Bledisloe (chairman) and Lord Bathurst (vice-chairman) urge that "never, in the best interests of British Agriculture, was there greater need than there is to-day for the practical training of our present and future landowners, estate agents and larger farmers in improved methods of agriculture, in the economic administration of rural estates, in practical forestry, or in local government."

We learn from the *Journal* of the American Medical Association that the Academia de Ciencias Médicas of Havana has announced the following prizes for the year 1921: President Gutiérrez' prize, 400 pesos, for the best work on the necessity of a National Formulary; Gañongo prize, 200 pesos for the best work on any medical subject; Gordon prize (physiology), a gold medal, for the best work on correlation of the endocrine glands. The papers must be sent to the secretary of the academy (calle de Cuba, número 84-A) before March 31, 1921. They must be original, must not have been published before, and may be in Spanish, English or French.

New Year honors conferred in Great Britain on scientific men are recorded in *Nature* as follows: *Privy Councillor:* The Rev. Dr. Thomas Hamilton, for service to the cause of education in Ireland, first as President of Queen's College, Belfast, and afterwards as President and Vice-Chancellor of the Queen's University of Belfast. *Knights:* Pro- P. R. Scott Lang, for more than forty years Regius professor of mathematics in the University of St. Andrews; Mr. P. J. Michelli, secretary to the London School of Tropical Medicine; Dr. S. S. Sprigge, editor of the *Lancet;* Professor James Walker, professor of chemistry, University of Edinburgh; and Dr. Dawson Williams, editor of the *British Medical Journal. C.M.G.:* Mr. I. B. Pole Evans, chief of the division of botany and plant pathology, Department of Agriculture, Union of South Africa. *C.I.E.: Lieutenant-Colonel* W. F. Harvey, director of the Central Research Institute, Kasauli, Punjab, and Dr. E. J. Butler, formerly Imperial Mycologist, Pusa. *K.C.V.O.:* Dr. F. S. Hewett.

The *Journal* of the American Medical Association states that its Paris exchanges for the last week in December were crowded with accounts of the elaborate festivities of the centenary of the Academy of Medicine. The entire issue of the *Presse médicale* for December 25 is devoted to an illustrated description, with the addresses delivered by Laveran, the present president of the academy, and others. The official delegates from other countries included sixteen from England, five from the United States; eleven from Belgium, including Bordet, Brachet and Willems; Arteaga, from Bolivia; O. de Oliveira, from Brazil; Córdova, Donoso, Orego and Sierra, from Chile; Esguerra and Machado from Colombia; Cueva and Villamar, from Ecuador; Nourgo and Nobles from Guatemala; Arce and Chutro, from Argentina; two delegates also from Peru; Silva, from Salvador; Carlos, Fonseca, Tijera, Rincones, Rísquez and Velásquez, from Venezuela; Ito and Tsuchiga from Japan; O. Pei-Huan, from China; Robert from Siam, and Cassens from Haiti. Twenty-nine countries were represented in all. A medal to commemorate the occasion was struck. The president of the republic of France was present with two of his ministers and all the préfets of the département. The celebration concluded with a banquet and a reception at the Palais d'Orsay. Toasts were offered at the banquet by Cassens, for Haiti; Recasens, for Spain; van der Berg, for Holland; Cueva, for Ecuador; Kalliontzis, for Greece, and Lucatello, for Italy. Wright, of England, was seated at the right hand of the president of the academy.

We learn from *Nature* that the British Air Ministry announces that the cabinet has approved, subject to parliamentary sanction, the grant of a sum for the direct assistance of civil aviation. During the financial year 1921–22 payments under this grant will be limited to a maximum sum of £60,000, and will be made to British companies operating on approved aerial routes. The routes at present approved are London to Paris, London to Brussels, and London to Amsterdam. Extensions to these routes and additional routes, such as England–Scandinavia, on which the possibilities of a service employing flying boats or amphibian machines or a mixed service of sea and land aircraft can be demonstrated, may be approved.

UNIVERSITY AND EDUCATIONAL NEWS

Announcement has been made at Brown University of the completion of the Nathaniel French Davis Fund in honor of Professor Davis, now emeritus, who was for forty-one years a teacher of mathematics in the university. The fund amounts to ten thousand dollars and the income is to supplement the regular library appropriations in purchasing mathematical books and periodicals for the mathematical seminary.

Dr. Victor C. Vaughan, for thirty years dean of the University of Michigan Medical School, has resigned. Dr. Vaughan has been professor of hygiene and physiological chemistry since 1884.

At Colgate University, Associate Professor A. W. Smith has been made full professor and head of the department of mathematics as successor to Professor J. M. Taylor. Professor T. R. Aude, of the Carnegie Institute of Technology, has been appointed associate professor of mathematics.

Dr. Solon Marx White, Minneapolis, professor of medicine at the University of Minnesota, has been appointed chief of the department of medicine to succeed Dr. Leonard G. Rowntree, now associated with the Mayo Clinic.

DISCUSSION AND CORRESPONDENCE

ON THE OCCURRENCE OF AËDES SOLLICITANS IN FRESH WATER POLLUTED BY ACID WASTE

It is believed to be of interest to students of mosquitoes to report the occurrence of *Aëdes sollicitans,* a salt marsh mosquito, in fresh water polluted by acid waste from a "guano factory." During October, 1920, while making investigations concerning fishes in relation to mosquito control at Savannah, Georgia, in cooperation with the U. S. Public Health Service and the city of Savannah, the writer found mosquito larvæ in ditches which were so strongly polluted that all other animal life appeared to be extinct. The larvæ were collected from time to time and reared to the adult stage. Dr. Bassett, bacteriologist for the city of Savannah, identified the species as *Aëdes sollicitans* and this determination later was verified by Dr. Dyar, of the U. S. Bureau of Entomology.

The acid content of the water in the ditches where the pollution was greatest was not determined but a water sample taken downstream where the pollution had become greatly diluted and where *Aëdes sollicitans* was replaced by *Anopheles crucians* and *Culex* sp. was titrated by Dr. Bassett and found to contain 2.08 per cent. of free acid and a large amount of iron. It is quite probable that the water in portions of the ditches in which the larvæ of *Aëdes sollicitans* were common had an acid content of fully 3 per cent.

The larvæ occurred most frequently along the edges of the ditches among decaying vegetation and they displayed a stronger resistance to the toxicity of oil than *Culex* and *Anopheles* larvæ occurring in the more weakly polluted portions of the same ditches.

Samuel F. Hildebrand
U. S. Bureau of Fisheries,
Washington, D. C.

THE HISTORY OF SCIENCE AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The application made to the council of the American Association for the Advancement of Science for the organization of a new Section to be devoted to the History of Science was de-

nied by the council (October 17, 1920), but permission was granted for those interested in the History of Science to enter Section L on "Historical and Philological Sciences," a Section which had never been organized and existed only in name.

The special committee appointed by the president of the association for the organization of a History of Science Section, recommended, on December 16, 1920, that the words "and philological" be dropped. This recommendation was likewise rejected by the council. It is clear, therefore, (1) that the council does not deem it wise to admit a separate section on the History of Science and (2) that the organization effected in Chicago on December 29, 1920, will not meet the needs of the increasing number of men interested in the History of Science, since, at any time, those representing "Philological Sciences" and the "Historical Sciences" (whatever that term may mean), may step in and give rise to a heterogeneous, incoherent group of workers, having no interests in common. If representatives of the "Philological Sciences" and "Historical Sciences" do not appear, then Section L constitutes in reality the very kind of organization which the council decreed should not be admitted as a Section.

In the judgment of the present writer, the dignified and logical procedure for those interested in the History of Science is, therefore, to withdraw altogether from organized historical work in connection with the American Association for the Advancement of Science until such time when the council and general session will be ready to welcome them into the association as a separate Section.

Florian Cajori

University of California

CONCERNING "AERIAL PHOTO-HYDROGRAPHY"

In an article[1] describing attempts to photograph "the small coral heads and pinnacle rocks" off the coast of Florida, E. Lester Jones of the United States Coast and Geodetic Survey concludes that:

> These experiments proved very conclusively that photographs from the air, using present-day equipment, are of little practical value to the hydrographer (p. 575).

Those interested in the study of underwater features may be interested in the opposite view published in *Comptes Rendus*.[2] Objects in French water were photographed to a maximum depth of 17 m. and several points of rock were revealed by the photographs which had escaped detection by other methods. ("Plusieurs têtes de roche qui avaient échappé aux levés détaillés et très exacts de ces parages ont été ainsi révélées par la photographie.") Specific instances are given where points of rock dangerous to shipping, not indicated on the hydrographic charts, were discovered by means of the photographs.

Perhaps the statement that photographs taken from the air are of little practical value is more conclusive than was intended.

Willis T. Lee

U. S. Geological Survey

SOIL COLOR STANDARDS

In order that there may be uniformity in the designation of the color of soils it is proposed that a set of color standards be prepared in which those colors which occur in soils and subsoils may be represented. Such a set of standard colors would be of great value to soil survey workers and would certainly lead to a better understanding of the descriptions of soils from the various regions of the United States and of the earth as a whole.

In order that such a set of color standards might be published representative soils from all parts of the United States would need to be examined. No doubt the Bureau of Soils of the United States Department of Agriculture could lead in the work and by consultation with various State Soil Surveys and with the Soil Surveys of other nations standardize the colors and publish reproductions of them as Robert Ridgway did in his "Color Standard and Color Nomenclature" (published by

1 Science, December 17, 1920.

2 Tome 169, 27 October, 1919.

the author, Washington, D. C., 1912). If it should seem impracticable to name all colors, a numerical system could be devised. The writer has felt the need of some such set of color standards in the Soil Survey work in South Dakota. Perhaps others may have felt the same need.

J. G. Hutton

S. D. Experiment Station

SCIENTIFIC BOOKS

The Letters of William James. Edited by his son, Henry James. Two volumes, xx + 348 and xiii + 382, The Atlantic Monthly Press, Boston, 1920. $10.00.

William James was one of the half dozen greatest Americans of his generation; he was also a past master of writing. Every one with intellectual interests will wish to read his letters. They will be well rewarded, whether they seek better acquaintance with a great man, or literature itself, or stimuli to reflections upon the conditions of scholarly and scientific work in America.

The most notable fact about James himself which the letters reveal and emphasize is that he was from youth a philosopher and moralist, tremendously interested in the world as a whole and in its deeper meanings. Painting, natural history and medicine, each for a brief time, and psychology for almost a score of years, restrained him from the study of fundamental questions and sweeping statements which really had his life-long allegiance. At the age of twenty-six, while studying medicine and expecting to earn his living by practising it, and while gaining considerable acquaintance with the best work of the time in physiology and psychology, he was reading Hegel and writing that Kant's "Kritik" "strikes me so far as almost the sturdiest and honestest piece of work I ever saw." In the partial list of his readings during the half year after he took his M.D. philosophy and religion outweighed science and medicine nearly ten to one.

In respect to the actual working of James's intellect, the letters probably do not add much to what the shrewd reader would infer from the "Principles of Psychology," the "Varieties of Religious Experience," "Pragmatism" and other writings. The letters show brilliantly the extreme fertility of mind, the receptivity to facts, theories and viewpoints of all sorts, the impulsive reaction to approve and make the best out of every man's offering, the intuitive sense of causes and consequences, and the perfect candor and directness. They do not show so well the sheer mastery in observing and organizing the facts of human nature and behavior, the final recognitions of truth and value, and the persistent refusal to tolerate inadequacies or imperfections by which James worked his way to them.

As literature the letters have the verve, the magic gift of epithet and the utter sincerity which, writing or speaking, James never lacked. His caricature, or possibly characterization, of the university professor will be often quoted:

—a being whose duty is to know everything, and have his own opinion about everything, connected with his *Fach*. . . . has the most prodigious faculty of appropriating and preserving knowledge, and as for opinions, he takes *au grand sérieux* his duties there. He says of each possible subject, "Here I must have an opinion. Let's see! What shall it be? How many possible opinions are there? three? four? Yes! just four! Shall I take one of these? It will seem more original to take a higher position, a sort of *Vermittelungsansicht* between them all. That I will do, etc., etc." So he acquires a complete assortment of opinions of his own; and, as his memory is so good, he seldom forgets which they are! But this is not reprehensible; it is admirable—from the professorial point of view.

He tells his little daughter of a big mastiff:

The ears and face are black, his eyes are yellow, his paws are magnificent, his tail keeps wagging *all* the time, and he makes on me the impression of an angel hid in a cloud. He longs to do good.

Of the subtleties in the theme and treatment of his brother's latest novels he writes:

You know how opposed your whole "third manner" of execution is to the literary ideals which

animate my crude and Orson-like breast, mine being to say a thing in one sentence as straight and explicit as it can be made, and then to drop it forever; yours being to avoid naming it straight, but by dint of breathing and sighing all round and round it, to arouse in the reader who may have had a similar perception already (Heaven help him if he hasn't!) the illusion of a solid object, made (like the "ghost" at the Polytechnic) wholly out of impalpable materials, air, and the prismatic interferences of light, ingeniously focused by mirrors upon empty space. But you *do* it, that's the queerness! And the complication of innuendo and associative reference on the enormous scale to which you give way to it does so *build out* the matter for the reader that the result is to solidify, by the mere bulk of the process, the like perception from which *he* has to start. As air, by dint of its volume, will weigh like a corporeal body; so his own poor little initial perception, swathed in this gigantic envelopment of suggestive atmosphere, grows like a germ into something vastly bigger and more substantial.

To this Henry James replied with unparalleled conciseness,

You shall have, after a little more patience, a reply to your so rich and luminous reflections on my book—a reply almost as interesting as, and far more illuminating than, your letter itself.

Of a night in the Adirondacks he writes:

I was in a wakeful mood before starting, having been awake since three, and I may have slept a little during this night; but I was not aware of sleeping at all. My companions, except Waldo Adler, were all motionless. The guide had got a magnificent provision of firewood, the sky swept itself clear of every trace of cloud or vapor, the wind entirely ceased, so that the fire-smoke rose straight up to heaven. The temperature was perfect either inside or outside the cabin, the moon rose and hung above the scene before midnight, leaving only a few of the larger stars visible, and I got into a state of spiritual alertness of the most vital description. The influences of Nature, the wholesomeness of the people round me, especially the good Pauline, the thought of you and the children, dear Harry on the wave, the problem of the Edinburgh lectures, all fermented within me till it became a regular Walpurgis Nacht. I spent a good deal of it in the woods, where the streaming moonlight lit up things in a magical checkered play, and it seemed as if the Gods of all the nature-mythologies were holding an indescribable meeting in my breast with the moral Gods of the inner life. . . . The intense significance of some sort, of the whole scene, if one could only *tell* the significance; the intense inhuman remoteness of its inner life, and yet the intense *appeal* of it; its everlasting freshness and its immemorial antiquity and decay; its utter Americanism, and every sort of patriotic suggestiveness, and you, and my relation to you part and parcel of it all, and beaten up with it, so that memory and sensation all whirled inexplicably together; it was indeed worth coming for, and worth repeating year by year, if repetition could only procure what in its nature I suppose must be all unplanned for and unexpected. It was one of the happiest lonesome nights of my existence, and I understand now what a poet is.

It would be unwise, within the limits of this review, to discuss the "Letters" as evidence concerning the forces which determine intellectual production and moral zeal in men of science. The readers of this journal will also prefer to draw their own conclusions. I note only a few matters which might not attract attention.

James writes apologetically of having the sole copy of the "Principles" insured for $1,000 in transit! In 1896, being then fifty-four, under the spell of Chicago,

I tried a stenographer and typewriter with an alleviation that seemed almost miraculous. I think I shall have to go in for one some hours a week at Cambridge. It just goes "whiff" and six or eight long letters are *done*.

Apparently he had spent seven years in Europe before ever going west of the Adirondacks; and seems not to have visited Yale or Princeton or Johns Hopkins or Columbia until he was fifty.

James's output seems to have been influenced greatly by outside pressure. Except for the enterprise of a publisher and the existence of the lecture foundations of Gifford, Lowell and the Columbia Department of Psychology, we might well have gone without the "Principles," "Varieties," and "Pragmatism," though we might, of course, have had something better. In the

prime of his life, when his ability was entirely obvious, James taught logic to beginners, extra courses in Radcliffe, and courses in summer schools!

Edward L. Thorndike

SPECIAL ARTICLES

NON-DISJUNCTION OF THE FOURTH CHROMOSOME OF DROSOPHILA

In *Drosophila melanogaster* the gene for "eyeless" (e) and its normal allelomorph (E) are situated in the small fourth chromosome. Normal eye is dominant.

When heterozygous Ee normal flies are crossed with eyeless ee, a ratio of 1:1 is expected. Actually this ratio is approached, although the greater viability of the normal type modifies the ratio to approximately 1.3:1.

In a single mating of this sort a count of 171 normal to 206 eyeless was obtained. Breeding tests of the descendants of this mating indicate that in all probability non-disjunction of the fourth chromosome has taken place.

If an Ee fly formed non-disjunctional gametes Ee and—, the cross with an ee individual would give rise to Eee flies. Here two doses of "eyeless" meet one of "normal" eye. The opportunity is given for an upset in the balance of dominance between E and e. The excess of eyeless flies, mentioned above, suggests that such an upset has taken place. Further matings make it appear that the Eee form may be *either* normal or eyeless in appearance, certain individuals being extremely difficult to classify.

In the course of the breeding work several interesting results were obtained. Among these was the isolation of *eyeless* flies, theoretically of the formula Eee, which when crossed *inter se* or with other eyeless ee, gave *normal eyed* progeny in considerable numbers. Ratios of 8, 9, 10 or even 12 normals to 1 eyeless were also produced from matings presumably EEe × Ee. Both these conditions were expected on the hypothesis of non-disjunction.

Using the appearance of eyeless flies as a test, it seems that the mitosis of the Eee flies is in the vast majority of cases, if not always, Ee and e; while similarly that of the EEe flies is Ee and E.

The variation in somatic appearance of the Eee form and the selective type of mitosis, referred to above, make it difficult to demonstrate genetically the presence of EeEe individuals. If flies of this type have occurred their mitosis is commonly Ee and Ee. One mating only indicates a possible exception to this type of mitosis. This mating shows a peculiar ratio possibly due to the presence of eee eyeless forms.

A further detailed report of the work will shortly be published. I am greatly indebted to Dr. E. G. Anderson for helpful suggestions and discussion and to the Misses E. E. Jones and D. M. Newman for assistance in the laboratory.

C. C. Little

Cold Spring Harbor, N. Y.,
January 6, 1921

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE TREASURER FOR 1920

In conformity with Article 2, Section 6, of the By-Laws and by direction of the Council, the Treasurer has the honor to submit the following report for the period December 20, 1919, to December 23, 1920.

The total cash receipts during the period in question is $13,096.05. These include $4,381.21 from the W. Hudson Stephens estate; $1,850 from 32 Life Membership commutations, and $5,707.75 from interest on securities of the association.

The total disbursements made during the period in question amount to $10,272.56. These include an aggregate of $4,500 for 19 grants authorized by the council, and $4,431.31 paid for $4,500 face value Victory Loan 4¾% bonds.

The total amount of funds of the association consisting of cost value of securities purchased, appraised value of securities received from the Colburn Estate, and cash in banks, is $125,723.59.

A balance sheet, showing assets and liabilities, and tables showing details of receipts and disbursements, are appended hereto.

(Signed) Robert S. Woodward,
Treasurer

Dated December 23, 1920

BALANCE SHEET—DECEMBER 23, 1920

Assets

Investments:		
Securities (Exhibit "A")		$119,242.41
Cash in Banks		6,481.18
		$125,723.59

Liabilities

Funds:		
Life Memberships:		
345 at $50	$17,250	
5 at $100	500	$ 17,750.00
Jane M. Smith Fund		5,000.00
W. Hudson Stephens Fund		4,381.21
Colburn Fund		77,755.74
Accumulated Investments		14,355.46
Unappropriated Interest		6,481.18
		$125,723.59

CASH STATEMENT

Receipts

Dec. 23, 1920.			
Balance from last report			$3,657.69
Interest from securities		$5,707.75	
Interest from bank balance.		51.72	
Interest from R. M. Yerkes.		5.37	
Revertment of grant made R. M. Yerkes		100.00	
10 Life Commutations, 1919		500.00	
22 Life Commutations, 1920:			
17 at $50	$850		
5 at $100	500	1,350.00	
Sustaining member		1,000.00	
Estate of W. H. Stephens.		4,381.21	13,096.05
			$16,753.74

Disbursements

Investments			
$ 100 U. S. First Liberty Loan 4%	$91.25		
$4,500 U. S. Victory Loan Bonds 4¾%:			
Purchase price.	$4,381.60		
Interest purchased	46.90		
Commission	2.81	4,431.31	$ 4,522.56
Grants:			
Samuel D. Robins	100.00		
S. Lefschetz	300.00		
Olive C. Hazlett	100.00		
A. A. Knowlton	200.00		
John C. Shedd	100.00		
Philip Fox	600.00		
Anne S. Young	100.00		
Frank B. Taylor	250.00		
S. I. Kornhauser	250.00		
P. W. Whiting	200.00		
Donald Reddick, Chr.	500.00		
Irving W. Bailey	500.00		
Daniel W. La Rue	200.00		
Margaret F. Washburn	200.00		
Jos. Peterson	200.00		
Asa A. Schaeffer	200.00		
Theo Hough	100.00		
Carl J. Wiggers	150.00		
Ferdinand Canu	250.00		4,500.00
Interest on Life Membership			
350 members at $3	1,050.00		
2 members (Jane M. Smith Fund)	200.00		1,250.00
Cash in Banks			
Fifth Avenue Bank	5,271.26		
U. S. Trust Company	1,209.92		6,481.18
			$16,753.74

I certify that I have audited the accounts of the Treasurer of the American Association for the Advancement of Science for the period December 20, 1919, to December 23, 1920; that the securities representing the investments of the association have been exhibited and verified; and that the income therefrom has been duly accounted for.

The financial statements accompanying the Treasurer's report are in accord with the books of the association and correctly summarize the accounts thereof

(Signed) Herbert A. Gill,
Auditor

Dated December 23, 1920

At the autumn meeting of the executive committee of the council, held in New York on October 17, 1920, the following report was received and ordered to be printed in Science. It covers only a portion of the fiscal year on account of the fact that the records of the Permanent Secretary's office were turned over to the new Permanent Secretary on April 1, 1920. The former Permanent Secretary, Dr. L. O. Howard, presented his resignation at the St. Louis meeting, at which he was elected president for 1920 and 1921, but the new Permanent Secretary, Dr. Burton E. Livingston, did not assume his duties until February 1, 1920, and did not actually take charge of the accounts until April 1, 1920. During the interim Dr. Howard continued to care for the affairs of the association, and he has given much valuable advice and assistance to the new Permanent Secretary. Dr.

SCHEDULE OF SECURITIES

Securities Purchased

Par Value		Purchase Value	
$10,000	Chicago & Northwestern Railway Co. general mortgage 4 per cent. bonds, due 1987	$9,425.00	
10,000	Atchison, Topeka & Santa Fe Railway Co. general mortgage 4 per cent. bonds, due 1995	9,287.50	
10,000	Great Northern Railway Co. first and refunding mortgage 4.25 per cent. bonds, due 1961	10,050.00	
10,000	Pennsylvania Railroad Co. consolidated mortgage 4.5 per cent. bonds, due 1960	10,487.50	
10,000	Chicago, Burlington & Quincy Railroad Co. general mortgage 4 per cent. bonds, due 1958	9,350.00	
10,000	Union Pacific Railroad Co. first lien and refunding mortgage 4 per cent. bonds, due 2008	9,012.50	
10,000	Northern Pacific Railway Co. prior lien railway and land grant 4 per cent. bonds, due 1997	9,187.50	
10,000	New York Central and Hudson River Railroad Co. 3.5 per cent. bonds, due 1997	8,237.50	
100	U. S. First Liberty Loan Bonds	91.25	
8,000	U. S. Second Liberty Loan Bonds	8,000.00	
2,000	U. S. Third Liberty Loan Bonds	2,000.00	
2,000	U. S. Fourth Liberty Loan Bonds	2,000.00	
6,500	U. S. Victory Liberty Loan Bonds	6,373.66	$93,502.41

Bonds from Colburn Estate

20,000	Acker, Merrall and Condit Co. debenture 6 per cent. bonds	$13,600.00	
7,000	Buffalo City Gas Co. First mortgage 5 per cent. bonds	1,540.00	
8,000	Park and Tilford Co. sinking fund debenture 6 per cent. bonds	6,400.00	
42,000	Pittsburgh, Shawmut & Northern Railroad first mortgage 4 per cent. bonds, due February 1, 1952	4,200.00	25,740.00
$171,000			$119,242.41

Howard's audited report for the period mentioned follows.

BURTON E. LIVINGSTON,
Permanent Secretary

October 23, 1920

PERMANENT SECRETARY'S REPORT FOR THE PERIOD NOVEMBER 1, 1919, TO MARCH 31, 1920

Dr.

To balance from last account		$5,988.90
To receipts from members:		
Annual dues previous to 1919	$119.00	
Dues for 1919	237.00	
Dues for 1920	36,367.50	
Admission fees	725.00	
Life membership fees	1,150.00	
Publications and misc. receipts	284.63	38,883.13
		$44,872.03

By publications:		
To publishers SCIENCE		$8,909.16
By expenses St. Louis meeting:		
Secretaries (sectional and press)	$709.26	
Other meeting expenses	328.02	1,037.28
By office expenses:		
Salaries	2,461.02	
Extra clerical help	1,233.42	
Postage, telegraph, telephone and express	891.13	
Addressograph supplies, etc.	397.45	
Stationery, forms, cards, circulars, etc.	2,040.84	
Overpaid dues returned	8.00	7,031.86
By balance turned over to Burton E. Livingston, new Permanent Secretary		27,893.73
		$44,872.03

L. O. HOWARD,
Permanent Secretary

I hereby certify that I have audited the foregoing accounts and find the same correct, and that proper vouchers covering disbursements were exhibited.

HERBERT A. GILL,
Auditor

WASHINGTON, D. C.,
October 12, 1920

FINANCIAL REPORT OF THE PERMANENT SECRETARY FOR THE PARTIAL YEAR, APRIL 1, 1920, TO SEPTEMBER 30, 1920[1]

Burton E. Livingston, permanent secretary, in account with the American Association for the Advancement of Science.

[1] See the report of Dr. L. O. Howard for the period from November 1, 1919, to March 31, 1920.

Dr.

To balance turned over by L. O. Howard, April 1, 1920:		
Checking account	$23,692.64	
Savings account	4,201.09	$27,893.73
To receipts from members:		
Annual dues previous to 1919	$31.00	
Annual dues 1919	79.50	
Annual dues 1920	11,121.50	
Annual dues 1921 (paid in advance)	204.18	
Admission fees	230.00	
Life membership fees....	200.00	11,866.18
To other receipts:		
Sales of publications	$10.75	
Miscellaneous receipts including postage, exchange on checks, overpayments on dues, etc.	137.43	
Interest on savings account.	26.25	174.43
		$39,934.34

Cr.

By Publications:		
Publishers Science		$21,204.31
By Division Expenses (refunds on memberships):		
Pacific Division	$1,755.00	
Southwestern Division ..	105.00	1,860.00
By Expenses, Washington Office:		
Salary Permanent Secretary	$1,250.01	
Salary, Executive Assistant	1,195.00	
Salary, Clerk	454.84	
Salary, F. S. Hazard....	200.00	
Extra clerical help	400.00	
Travel expenses, Permanent Secretary	120.27	
Office supplies	354.75	
Stationery and printing...	1,979.53	
Telephone and telegraph and express	74.28	
Furniture	219.81	
Postage	545.32	
Exchange on checks......	11.72	
Bad checks of members unredeemed	10.00	
Duplicating work	25.93	$6,841.46
By miscellaneous expenses:		
Life membership commutations, to Treasurer...	$500.00	
Travel expenses, Executive Committee	169.02	
Expenses, Grants Committee	33.95	
Refunds of overpaid dues.	131.00	
Refunds of payments for old membership lists...	4.50	
Refunds to academies on national members having paid dues for 1920.....	557.00	
Membership in American Council on Education...	10.00	
Moving to third floor.....	5.00	
Notary fees	.25	
Expenses of Committee on Permanent Secretary ..	33.00	
Loss on Canadian Currency	.26	1,443.98
		$31,349.75
By new balances:		
American National Bank:		
Checking account	$4,344.04	
Savings account	4,227.34	
Petty cash fund	13.21	8,584.59
		$39,934.34

I certify that I have audited the accounts of the Permanent Secretary of the American Association for the Advancement of Science for the period April 1, 1920, to September 30, 1920; that they were found correct, and that proper vouchers covering disbursements were exhibited.

(Signed) Herbert A. Gill,
Auditor

Washington, D. C.,
January 17, 1921

SCIENCE

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SCIENCE

FRIDAY, FEBRUARY 25, 1921

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PUBLIC HEALTH WORK OF PROFESSOR SEDGWICK[1]

WILLIAM THOMPSON SEDGWICK, son of William and Anne Thompson Sedgwick, was born at West Hartford, Connecticut, December 29, 1855. His colonial ancestor was Robert Sedgwick, who settled in Boston in 1636. He studied at the Sheffield Scientific School, the Yale Medical School, and Johns Hopkins University. On his twenty-sixth birthday he married Mary Katrine Rice, at New Haven, Connecticut. In 1883 he came to Boston and the Massachusetts Institute of Technology, where for thirty-eight years he was professor of biology and public health. He died at Boston, January 25, 1921, at the age of sixty-five.

These simple facts tell who Professor Sedgwick was. But what he was and what his life meant to the people of Boston, to hundreds of young students, to the science of public health, and to the Commonwealth of Massachusetts can not yet be told or even estimated. His death is too recent and our thoughts are still so touched with sadness that one can not adequately picture his manifold activities or form a just appreciation of his life or his place in history. But in the various eulogies already written a few words stand out prominently and must be regarded as characteristic of the man. The words are service, public service, kindliness, serenity, inspiration, buoyant optimism, love of young men. Let these suffice. They are eulogy enough for any man.

I can not write about Professor Sedgwick's work in public health without saying more about my own relations to it than is becoming on such an occasion—but it is characteristic of his work that it was not done in the seclusion

[1] A memorial address delivered at Unity House, Boston, February 6, 1921, by Professor George C. Whipple, of Harvard University. Professor Sedgwick was to have spoken at this meeting on the subject of Child Welfare.

of his study and laboratory, but involved all those with whom he came in contact.

I first knew Professor Sedgwick when I was a student of engineering and he professor of biology at the Institute of Technology. He was thirty-three and I was twenty-two. For the first time (1888–89) he was giving a course of lectures in bacteriology to civil engineers. It was an innovation. Until then sanitary engineering had leaned for its support on chemistry, but here was a new science coming to its aid. I have in my study the notes which I took of Professor Sedgwick's weekly lectures. They began as follows: "The sanitarian needs a proper working theory." Then he proceeded to develop the germ theory of disease as he had learned it from Pasteur and other European scientists who were laying the foundations of that science which has done so much for the health of the world. He showed how physicians and engineers had been wrong, how they had groped in the dark, and how, by applying the recently discovered principles of biology, it was possible to give to sanitary engineering new life. Of course, Sedgwick was not the only American to take up with the new ideas. There was Dr. Welch at Johns Hopkins, Dr. Biggs in New York, and others who were doing the same thing. But these other men were in medical schools; Sedgwick was in the Institute of Technology where the engineering sciences predominated and therefore his influence on sanitary engineering was the greatest. Nor would it be right to ignore the work of his colleagues in chemistry, such as Professor William Ripley Nichols and Dr. Thomas M. Drown. It was the combination of chemistry and biology with engineering which made the profession of sanitary engineering what it is—a profession which we are proud to think has become more highly developed in America than in any other country.

It is important to keep in mind certain dates in connection with the work of these Massachusetts scientists. Louis Pasteur's pioneer work in bacteriology was done in the seventies. In 1876 Robert Koch discovered the germ of anthrax. In 1882 he suggested the use of solid culture media and thus made it possible to consider bacteria in a quantitative way. In 1880, Eberth found the bacillus of typhoid fever. In the same year Laveran had discovered the malarial parasite. In 1883–84 Klebs and Löffler found the germ of diphtheria. In 1883 Koch found the cholera spirillum. And it was in 1883 that Sedgwick undertook his work in Boston. No wonder that he saw a great future for his beloved science of biology; no wonder that he gave up his intention of being a physician.

Sedgwick did not study bacteriology in Europe, but I remember hearing him tell how he received what was perhaps the first batch of Dr. Koch's sterilized nutrient gelatine sent to this country. Professor Nichols brought it over and probably had not realized its physical properties, for it had melted, had saturated the cotton plug of the flask, had oozed out, had become infected and nauseating and was about as far from having the required bacterial purity of a culture medium as one could imagine. It was an inauspicious beginning for bacteriology at the Institute. Professor Nichols must have chuckled over it, for at that time he did not share Sedgwick's optimism in regard to the future of bacteriology.

I remember those first lectures of Sedgwick's. He would hold up a glass of water and talk for an hour about what it contained. He would scare us to death by saying that it contained enough germs of typhoid fever to give the disease to a thousand people, and then go on to show how sanitary engineers could make the water safe to drink.

He started his students off on a hunt for bacteria. One of them studied the bacteria found in air—especially the air of hospitals—for he was hunting for big game. Together they devised a method for straining the bacteria from the air—an aerobioscope—a method still used. Another student helped him to study water—not only its bacteria, but its other microscopic organisms—those algæ which recently caused the bad taste in the water supply of Boston, when for a few weeks it was necessary to draw upon the old Lake Cochituate supply. Another new method of study

was devised—the Sedgwick Rafter method—still used to-day.

One of his students took up the study of milk; another that of food; and to-day the Institute has an important department of industrial biology. Several studied sewage and its methods of treatment, and for years this continued to be a fruitful field of research. Another studied the bacteriology of ice; another the bacteriology of soil. Then there were studies of particular species of bacteria—the longevity of the typhoid bacillus, and so on. The reason for mentioning these things is to illustrate the breadth of the investigations and the fact that Sedgwick always worked with and through his students. He did very little scientific work alone and he generally gave to his students more than a fair share of the credit for the work done.

We hear much said to-day about research, about the advantages of organized research. In my opinion there is danger that research may be organized to death. The compilation of facts by committees of learned societies is all very well, tests by competent scientists in government bureaus are desirable, and research conducted by the experts of great corporations are necessary in order that modern science may be applied in the most economical way to human needs—but the highest type of research is that which takes place in a university laboratory where an inspired teacher and his mature students sit down side by side and in quiet study endeavor to search out the secrets of nature and the chemical, biological, and physical laws of God. Let the scientists of America not follow too much the method of organized research—let them give even greater weight to the individual method of Huxley and Pasteur and Sedgwick.

When, after a long experience as a practising engineer, I came to Harvard to teach, I had many talks with Sedgwick about methods of teaching. He was no longer thirty-three years old, but fifty-five. He had been teaching for twenty-five years and he gave from his experience. He said, "I keep three things in mind—the past, the present, and the future. First, I teach by the historical method. That has two advantages: my students learn what has been done, and my lectures don't have to be written over every year. Second, I teach of what is going on now." His present-day students knew well his habit of rushing into the lecture-room with a clipping from the morning paper or a copy of the *Medical Journal* and talking about something which somebody had discovered in Chicago or the Fiji Islands, or about some new engineering project. All kinds of fish were caught in his net, and he believed that the students should study these fish while they were alive. Thirdly, he said, "I try to teach of what is likely to happen in the future. I try to make the students see the problems they will be up against." History, present problems, and research—these were his three principles.

His teaching was far from being exact. Sedgwick did not have a mathematical mind. His lectures were never formally prepared and as he grew older they became less methodical. He cared for general principles more than for details. The opening sentence of his first lecture to engineers, which I have already quoted, shows what he wanted most to impress upon his students. "The sanitarian needs a proper working theory." But it was chiefly his personal magnetism and his inspiration which told on his students, and this never failed him. His optimism was as strong at sixty-five as it was at thirty-five.

Sedgwick will be remembered first and foremost as a great teacher—yes, even as a teacher of teachers—because his enthusiasm was contagious and others followed in his steps. One has only to mention Dr. Calkins, of Columbia; Dr. Jordan, of Chicago; Dr. Winslow, of Yale; Professor Gunn, and other names, now well known, to realize the extent of Sedgwick's influence as a teacher upon teachers. But among his pupils are sanitary engineers, bacteriologists, health officers, laboratory workers in many fields, Red Cross officials, physicians, nurses, manufacturers, teachers of domestic science, housewives—men and women, a great company of enthusiastic followers who recognized him as "Chief."

Soon after Sedgwick came to Boston the

Massachusetts State Board of Health began to apply the new ideas in biology and chemistry to the purification of water and sewage under the leadership of Dr. Henry P. Walcott, who for a quarter of a century was chairman of the board, and Mr. Hiram F. Mills, a hydraulic engineer, who for an equally long time gave most valuable service to the commonwealth. A small station for making experiments with sewage and water was built at Lawrence, Mass. Professor Sedgwick was consulting biologist of the State Board of Health and Dr. Drown was consulting chemist. For many years, even up to this day, the Lawrence Experiment Station has been a center of scientific activity. Some of the leading sanitary engineers of the country began their work there.

While this scientific study of the chemistry and biology of water and sewage was in full blast (1890), a notable epidemic of typhoid fever swept down the Merrimac Valley. Professor Sedgwick made a thorough study of this catastrophe and developed methods of investigation which have been followed by American epidemiologists ever since. Although not a mathematician, he marshalled statistics and used them with telling force and drew from them logical conclusions which could not be upset. As a result of the epidemic and the research at the experiment station, the first scientifically designed municipal water filter in America was built at Lawrence. This filter, with additions and modifications, is still in use and although outgrown in size and ideas is to-day protecting the people of Lawrence against the recurrence of an epidemic like that of 1890. In this matter one can not give the credit to Sedgwick alone, for it was the entire group of scientists who deserve the credit—Mills, Stearns, Drown, Sedgwick, Hazen, Fuller, and others, most of all perhaps to Mr. Mills. Through them America gave to the world scientific ideas in regard to the disposal of sewage which revolutionized methods of treatment and stimulated the construction of disposal works in scores, perhaps hundreds of cities, in this country and abroad.

Sedgwick become a great interpreter of this scientific work. He joined the New England Water Works Association in 1890, but as early as 1888 he had contributed a paper on the Biological Examination of Water. He was chosen president of the association in 1906, having already (in 1904) been made an honorary member. His last address before the association was delivered on September 11, 1918, on a subject appropriate to the times, "From Peace to War, from War to Victory, from Victory to Just Judgment." Those who heard it will never forget the stirring words in which he called for stern justice for Germany and appealed to a higher ideal of God than that held by the Kaiser—the ideal of Christianity, the ideal of civilization. Sedgwick never separated his science from his patriotism or his religion. He could make science popular and he could take subjects of popular interest and clothe them in the language of science.

The American Public Health Association also claimed Sedgwick's attention. He became a member in 1902 and its president in 1915. He was a member of many committees, was a frequent speaker, most of his addresses having relation to the broader aspects of public-health work. It is hardly worth while at this time to recite the long list of scientific societies to which he belonged, but mention should be made of the Society of American Bacteriologists, which he helped to found and of which he was president in 1900, of the American Society of Naturalists, over which he presided in 1901, and the American Academy of Arts and Sciences, of which he was a Fellow and to which he gave much time and thought. Society memberships measure the breadth of a man's interest and give him opportunities for bringing his ideas before the scientific world. Some men are merely "belongers"—others, like Sedgwick, do their full part in promoting the objects of the societies which they join. As Professor Sedgwick advanced in life, his interest changed from one scientific society to another and his scientific papers shifted from the record of detailed studies to educational and philosoph-

ical problems. That change marked the normal development of an active, broadening mind. So we may add to Sedgwick's fame as a great teacher that of interpreter of science.

We must next look upon him as a councilor in public health. In 1914 when the State Board of Health was replaced by a health commissioner and public health council, Sedgwick was appointed as a member of the council and served in that capacity until his death. Together the commissioner and council constitute the State Department of Public Health. Its work is done partly through committees and Sedgwick served on the committee on sanitary engineering and was chairman of the committee on food and drugs. It is difficult to pick out from the many-sided activities of the State Department any particular work which was his, for in one way or another he has been in all of them. He was an ideal councilor. His scientific knowledge, his ripe experience, his grasp of fundamental principles made his advice respected by us all. His facility in writing clear and simple English was most useful to the council in the preparation of reports. I remember once that a certain sentence in a letter of advice to some city had been so phrased as to mean just exactly what it was not intended to mean. The commissioner and council had approved it. Sedgwick came in late, looked at the report, and immediately spotted the false phrase and thought it a great joke. He said, "Folks laugh at the sleepy old professors, but you see they have their uses." Sedgwick's graceful yet forceful manner of speaking caused him to be chosen on many occasions to represent the Department and whether he spoke before a legislative committee or a large public meeting he was always effective. Many a fight he has had at the State House with anti-vivisectionists, anti-vaccinationists, and various other kinds of antis—but Sedgwick's method of fighting was merely to state his side of the case, simply and forcefully, letting his opponent have a monopoly of the fireworks. It was perhaps one of his faults that he was not aggressive enough. But on occasion Sedgwick became eloquent. Last year at the Brussels conference of public health officers representatives of various nations, gorgeously arrayed in uniform and regalia, had been droning out weary speeches, the audience being visibly bored, when Sedgwick's turn came. He was there to represent the American Public Health Association, Harvard University, the Massachusetts Institute of Technology, and the U. S. Public Health Service. Simply dressed in his academic robes, he arose and spoke for ten minutes. He praised brave little Belgium and faithful France for saving the world, he gave to England the credit of being the father of public health administration, and then spoke for America. I do not know what he said—I was not there—but I have been told that the audience went wild in applause and that scores of people, including our own Ambassador, went forward after the meeting to shake his hand. It was the climax of the convention.

Professor Sedgwick of late had been keenly interested in the engineering study now being carried on jointly by the State Department of Public Health and the Metropolitan District Commission which looks forward to an extension of the water supply of the eastern part of the state, by the construction of a great reservoir in the Swift River Valley. Once in about twenty-five years every growing city or district has to enlarge its water supply, because it does not pay to construct works for a longer period ahead. It was in 1895 that the Wachusett Reservoir was recommended and a few years later put in use—and the time has now come when we of this generation must build a water supply for the next. It will be an expensive investment for the state, but not an unreasonable one, because it will be an income-producing investment. The project is one which appeals to the imagination. An abundant supply of pure water is one of the essentials of life. No community can prosper if it outgrows its water supply. Sedgwick, with his faith in Massachusetts, was therefore keenly alive to the importance of this new project, of which much will be heard during the coming year.

As early as 1882 Professor Sedgwick was elected a member of the Advisory Committee of the U. S. Public Health Service, and for nearly twenty years he maintained this connection with national public health affairs. When after the war a reserve organization was created in this service, Sedgwick was commissioned as assistant surgeon general. A few years ago he was made a member of the International Health Board, supported by the Rockefeller Foundation, and thus his interests became world-wide in their scope. Last year he went to England as exchange professor from the Massachusetts Institute of Technology to the Universities of Cambridge and Leeds—and on the eve of his departure a newspaper headline very fittingly characterized him as "Ambassador of Health."

During the past few days I have been reading over a list of the titles of the books and most important scientific papers which Sedgwick wrote between the years 1883 and 1921—about a hundred in number. If his minor writings had been included, the list would have been several times as long. Towards the end of his life he wrote less. Only a few weeks before his death he said to me, "I sometimes get sick of talking about health; every Tom, Dick and Harry is now talking about it, and most of what they say is so exaggerated that it casts discredit on all of us who are trying to speak within the bounds of sanitary science."

And I wish to take this occasion to express my own views that just as there is danger that scientific research may be organized to death, so there is danger that public health may be organized and legislated, propagandized and commercialized to the point of nullification. There is danger that over striving for the welfare of particular classes of people may result in misfortune to the people as a whole. Sensible education in the principles of healthy living should be universal, but neither the state nor the nation should embark upon programs of socialization of medicine, socialization of nursing or the paternalistic or maternalistic care of the health of individuals without first looking ahead to see where such policies lead, socially, financially and politically. The police power of the state should be used severely to prevent crimes against the public health; the advisory powers of health departments should be freely used, but the treasury of the state should not be drawn upon to pay for personal benefits or class benefits even in the name of health. Public health and private health are not the same, and governments may do for the one what they ought not to do for the other.

We Americans can not boast of the success of our governments, especially the governments of our cities. We can not boast of our governmental methods of public health administration—and unfortunately our local governments are not becoming more efficient as they become larger. Let us not therefore make the mistake of turning too many of our health activities over to the governments. In one thing, however, America has excelled and that is its voluntary cooperative undertakings. Let these continue to use their influence for improving personal health, leaving to the governments only those matters which legitimately belong to the health of the people as a whole. The time is rapidly approaching when the financial problems of our cities and states will overtop all others—sanitary and public health problems included—when appropriations of all kinds will be cut to the bone to ward off insolvency or repudiation of debts. Let us not make our people too dependent on their governments for health protection, but let us by education seek to make them protect their own health, for what they pay for they will value most.

There is one other aspect of health activities which I can not refrain from mentioning in this connection. Too much thinking about one's health makes a person morbid. It is possible for communities to get into the same condition. After all, there is more health in the world than there is sickness. I tell my students that while as professional health officials they must study death-rates, as individuals they must look well to the life rates, for except in old age the chance of living is far greater than the chance of dying

and we can sepnd our time best by living and not trying to stay alive. Fortunately, health is a positive quality which can be cultivated in ways that are pleasant, and with reasonable understanding and moderate care we can protect ourselves against those diseases which are preventable.

I am personally out of sympathy with injecting the propaganda and the slogans of public health into the services of the churches, although I am most heartily in favor of church people doing all that they can to mitigate human suffering by methods of prevention as well as those of relief. This concerted movement of the women of Boston to improve the health of our children strikes a responsive chord in all of us. We know that Professor Sedgwick's voice would have been lifted up in favor of this weeks' crusade. His very heart went out to the refugee children of France, and one of the most beautiful episodes of his life was associated with Château Lafayette, which he and Mrs. Sedgwick visited last summer and to which they hoped to return.

We come finally to Sedgwick's last great work in connection with the School of Public Health of Harvard University and the Massachusetts Institute of Technology. This school he helped to establish in 1913 and served as chairman of the administrative board until his death. He delighted to see it grow, he delighted to see students coming to it from foreign countries—from Italy, from China, from South America, from India and Siam, from Czecho-Slovakia, and from Mexico. Few people of Boston realize how solidly this little school has taken its place as a center of public-health education, or how its example has been followed by other universities in America.

Nearly twenty years ago when Sedgwick joined the American Public Health Association, he was made a member of a committee on the Teaching of Hygiene and the Granting of the Degree of Doctor of Public Health. He always held the view that the public health service was different from the medical service, that a man could be an efficient health executive without being a doctor. His last important address, given at the 100th anniversary of the medical school of the University of Cincinnati, was devoted to the subject of the education of health executives. He advocated what he called the Y plan, by which medical schools should have two programs, alike during the first two years, but afterwards diverging, one towards the degree of doctor of medicine and one towards the degree of doctor of public health.

His last act as a member of the administrative board of the School of Public Health, held December 19, 1920, was to assist in preparing a statement relative to the future of the school, planning for a reorganization of its government and doing so at the sacrifice of his own position as chairman and having in mind only the future good of the cause of public health education. In time to come Sedgwick's part in the organization of this school, which seems destined to take its place side by side with the Harvard Medical School, will stand forth as one of his most constructive works. May it not be possible that in the near future some friend or group of friends will contribute a fund big enough to endow a William Thompson Sedgwick professorship in this School of Public Health of Harvard University and the Massachusetts Institute of Technology which he loved so well. What finer memorial could be given than one which would tend to make his name and teaching known to the students of the coming years!

And so we may sum up Professor Sedgwick's life as that of a great teacher, an interpreter of science, a wise councilor, an ambassador of public health. Friend of young men, loyal supporter of the institute, patriotic citizen, a Christian gentleman, he will be greatly missed by all who were fortunate enough to know him.

On Sunday mornings I like to hear the Harvard student choir sing in Appleton Chapel. Sometimes the music rises and falls in varying melody until at the end it fades away as in a distance. At other times it pursues a simple motif, which grows in volume until it culminates in a burst of song and, on a sudden, ceases. For an instant the air tingles

and is still. But the memory of the glorious chord goes with us through the day "to charm, to strengthen, and to teach." Thus it was that Professor Sedgwick lived and died and stays forever in our hearts

George C. Whipple

OUR DISAPPEARING WILD PLANTS[1]

The destruction of the vast herds of bison on our western plains, the total extinction of the formerly abundant wild pigeon, the extermination of many of the most beautiful of our wild birds, all this is a matter of common knowledge. How many of us, however, realize that the same rapacious spirit of destruction has seriously endangered our wild plant life, until many of our most desirable plants have actually disappeared from wide areas of our country?

The earliest Europeans in America found in the New World a flora marvelously rich in its abundance of species and indescribably beautiful in its display of attractive plants. Since the time of the earliest settlers this wonderful flora has suffered a gradual depletion until at present the flora in many regions is a mere relic of the past with hardly a suggestion of its pristine loveliness. The appreciation of mankind was expressed in an odd manner indeed when he removed the handsomest of the plants, allowing the dull and less attractive species to take their place. This painful tragedy has been enacted right here in the vicinity of Washington, where the formerly luxuriant display of laurel, rhododendron, holly, ground pines, and arbutus has in many places been supplanted by weedy and generally unattractive species. All the plants named are almost extinct within a wide radius of the city and the wild orchids, spring beauties, bluebells, and many other species of rare grace and beauty are vanishing rapidly, and will soon live in memory only unless active steps are taken to save them.

The causes leading to their disappearance are complex, but by far the greatest contributing factor is the unrestricted, indiscriminate, thoughtless picking to which these beauteous plants are subjected. Each spring witnesses the descent of legions of thoughtless flower-gatherers who ravish the flora with hardly a thought that the tearing away of the flowers robs most plants of their only methods of reproduction. These misguided hordes gather huge armfuls and basketfuls of hepatica, anemone, bloodroot and dozens of other rapidly-wilting plants, which are enjoyed for the moment but are soon strewn along the highways and byways in withered, unsightly masses, mute evidence of wanton destruction of nature's most perfect gifts. The process of extermination has of late been largely aided and widely extended by that new enemy of our flora, the automobile, penetrating into regions formerly remote or inaccessible and returning loaded with huge piles of drooping, withered branches of flowering dogwood, redbud, and service berry, torn out by trespassers who had neither moral nor legal justication for such disfiguration. Who has not seen great branches of dogwood and bunches of other wild flowers offered for sale by irresponsible street-merchants? Within a half-hour during an automobile drive while the redbud and flowering dogwood were in bloom, the speaker was accosted twelve times along Conduit Road near Washington, D. C., by boyish flower venders offering their ill-gotten wares. The accumulated destruction of years will be great until it is inevitable that the handsomest of our species will disappear.

Must these wondrous gifts of nature live only in song and story for the countless oncoming generations? Is it fair that we dissipate this great natural heritage, robbing posterity of the pleasures derived from our flowers which we now so fully enjoy? It would seem that the doctrine of the greatest good for the greatest number demands that we accept this rich birthright in guardian spirit, to be safeguarded and preserved for the enjoyment of those who come after us; that each generation act as trustees of the surrounding

[1] An address delivered with illustrations before the Botanical Society of Washington, D. C., October 5, 1920.

flora, executing its trust in such a manner that the beauty of our native wild plants may continue in perpetuity.

The danger to our wild flora is so great as to have already been recognized by legislators. A recent Maryland law forbids the removal of plants unless either the written consent of the owner of the premises has been obtained or else under the owner's personal supervision. If such consent is not obtained, the picking of wild flowers is a misdemeanor, punishable by a fine of from five to twenty-five dollars, by imprisonment from thirty to ninety days or by the infliction of both of these punishments. Of far greater importance than the fear of punishment, however, is the creation of an appreciative sentiment in favor of the plants, because, after all, the ruthless destroyers are really the friends of the flowers, considerate and kindly disposed, but thoughtless in their acts. Usually a mere suggestion is thrice more powerful than a threat. The speaker is reminded of an experience with a college class in botany to whom he had talked on this subject. Some time later while on an excursion into the mountains, a single lady's slipper was encountered as a relic of a formerly abundant flora of this gorgeous wild orchid. Instead of the usual desire to pick and wear, the flower was allowed to remain on the stalk, perhaps to set seed and repopulate the vicinity with this splendid plant. No amount of legislation would have saved it; the appreciation of the class was shown by allowing the flower to remain for others to enjoy. A thousand people can enjoy what a single hand could destroy forever.

The remedy for the situation is to substitute the present wanton, promiscuous, unguided methods of gathering plants with regulated, sane and rational means. It is not at all necessary to forbid the picking of flowers, but sufficient should always be allowed to remain, particularly in the case of annuals, to produce seed and so perpetuate the species. Plants should never be gathered by the roots, as is so frequently the case with hepatica, anemone and bird-foot violet. Plants growing from long, creeping stems, as arbutus and ground pine (lycopodium) should never be torn out. It is best to cut the flowering stems of arbutus either with a sharp knife or a pair of scissors, allowing the long, leafy stem to continue its work of flower-production. The beauty of shrubs should never be violated by tearing the branches and in so doing peeling the bark to the base, thereby not only disfiguring the plant but also creating ready access for the entrance of fungi and other enemies which cause death. In case it is felt necessary to remove some of the branches of flowering shrubs, it is best to select such members as will mar the beauty least and cut them close to the base with a sharp knife in such a manner that the bark will eventually callous over the wound. Phlox, wintergreen and other scarce wild plants should never be purchased either from florists or street vendors. because by so doing one merely encourages the commercial exploitation of the wild flora. Recently the speaker witnessed an exhibition of goods placed upon a background of many square yards of moss torn from neighboring woods. Such a carpet of moss took nature scores of years to build up and it should not be destroyed in a moment, to be replaced by a huge bare spot where formerly all was green. The appreciation of the beauties of nature should be taught in our schools and churches where a mere hint of the situation is all that is necessary to insure hearty cooperation. Much can also be done by the establishment of private preserves for wild life, where the flora and fauna may exist undisturbed in primeval splendor.

It is especially desirable that plants such as the wintergreen be allowed to mature fruit as food for birds during the harsh winter months. Without this source of food, many birds die of winter starvation. It is desirable that the picking of such weedy but attractive plants as daisies, buttercups, golden rod and asters be encouraged, since by so doing no harm results and the farmer is assisted with his weed problem. In addition, the cultivation of wild plants in our gardens may save many species for the enjoyment of future generations.

We have sufficient precedence from other regions to guide us, as the total extinction of the yellow moccasin flower in Center county, Pennsylvania, and the extirpation of the pitcher plant, fringed gentian, azalea and wild lilies from many localities. We should profit from the experience of others and treat our wild flora as a natural resource which should be neither squandered nor destroyed, but should rather be treated in a sane and thoughtful manner, so that it may be appreciated and enjoyed by those who follow us.

Albert A. Hansen

A SUGGESTION FOR MAKING OUR SCIENTIFIC PUBLICATIONS MORE USEFUL AND OUR POST-OFFICES A CENTER OF INFORMATION

It is evident to all persons who have thought about the matter that our federal and state scientific publications are not as widely used or as well known as their great value to the public warrants. There are two principal reasons for this: first, because it is difficult to promptly obtain them and, second, because comparatively few people know of their existence as the government has found no effective way of advertising them.

Sportsmen and scientists, for example, frequently find that the guides of a region of which an excellent topographic map has been made by the government are not aware of the existence of the map although it would be of great value to them in their work. It is perhaps conservative to say that most automobilists do not even know what topographic maps are, and that, when they do know, they can not obtain them unless their tour is planned long in advance. The writer has never but once seen a topographic map in the home of a farmer, notwithstanding the fact that it would be a source of great pleasure and profit to him. If a publishing house had issued maps of such excellence it would have expended thousands of dollars in advertising them so that, if possible, every home might have a map of its own neighborhood. As a matter of fact the expense of publishing these maps is so great that no private concern could make them for sale at a profit. Nevertheless, after they have been published, no effort is made to let the people whose taxes paid for them learn of them and of their value.

A few examples from the writer's experience—which can be duplicated by many persons—will illustrate the characteristic inaccessibility of our federal and state publications. Many times he has wanted the topographic maps of a region but was unable to obtain them because he could not wait until he received them from Washington. At Zion National Park, Utah, this past summer not only were no topographic maps for sale but none could be consulted. At Uvalde, Texas, there are some interesting volcanic necks which are mapped and described in a United States Geological Survey Folio but when the writer stopped off to study them he found that no folio was available and, as far as he could learn, no one in the region owned a copy. At Ardmore, Okla., he wished to consult the geological literature of the region and found that the Carnegie Library has neither the publications of its own state nor the excellent United States Geological Survey Professional paper of the region. Many similar instances could be cited.

The biological and botanical publications are equally inaccessible. The archeological publications dealing with the Cliff Dwellings, the prehistoric ruins of New Mexico and Arizona, the Mound Builders of Ohio, and elsewhere, might almost as well never have been published as far as their usefulness to the visitor who has not had time to secure them from Washington is concerned.

The only justification for this state of affairs is that one can obtain the government publications in Washington and the state publications at the state capitols by writing for them; but it should always be added "if one has the time to wait for them."

The writer proposes two remedies:

1. That every first, second, and third class post-office shall be provided with a framed, printed list of the federal and state publica-

tions which deal with the region in which it is situated as well as of historical and other publications of local interest. It is, perhaps, evident that if it became generally known that every first, second, and third class post-office contained such a list of publications the traveler and resident in search of information would immediately go to the post-office to consult the list.

2. The second suggestion is that every postmaster shall have on sale all of the federal and state publications on the exhibited list.

In order to put this suggestion in practical form the writer prepared the following list for his home town:

PUBLICATIONS ON WILLIAMSTOWN AND VICINITY

Maps

The Greylock, Bennington, Berlin, and Wilmington topographic maps published by the United States Geological Survey. Show the location of roads, streams, houses, and elevations. On exhibition and for sale here.

Local History

"Origins in Williamstown," by Professor A. L. Perry. An account of the early history of the Northern Berkshires. Can be consulted in the Village and College Libraries.

"A History of Williams College," by Professor L. W. Spring. A history of the local college from its foundation to 1916. Can be consulted in the Village and College Libraries.

"Boyhood Reminiscences," by Keyes Danforth. Published in 1895. An interesting account of the houses, people, and customs of the time. Can be consulted in the Village and College Libraries.

Geology

"Taconic Physiography," by T. Nelson Dale, U. S. Geological Survey Bulletin 272. Contains excellent descriptions and explanations of the scenery of the Berkshires. Can be consulted in the Village and College Libraries.

"Geology of the Green Mountains," by Pumpelly, Wolfe, and Dale. United States Geological Survey Monograph XXIII. Contains a technical discussion of the geology of the region. Can be consulted in the Village and College Libraries.

"Final Report of the Geology of Massachusetts, 1841," by Edward Hitchcock. Interesting chiefly from a historical point of view. Can be consulted in the College Library.

Zoology

"Birds of New York," by E. H. Eaton. New York State Museum Memoir 12. Illustrates, with 106 colored plates, the birds of New York and New England. Can be consulted in the College Library.

"Useful Birds and their Protection," Edward H. Forbush. Massachusetts Bureau of Agriculture. An illustrated and interesting book on the birds of the state. Contains brief descriptions of the more common birds and accounts of their food and habits. Can be consulted in the Village and College Libraries.

Botany

"Wild Flowers of New York," by H. D. House. New York State Museum Memoir 15. Illustrated with many admirable colored plates. As the New York and New England species are for the most part identical this volume is as valuable for Williamstown as for New York. Can be consulted in the College Library.

"Bog Trotting for Orchids," Grace Greylock Niles. A popular description of the kinds and habits of orchids in this region. Can be consulted in the Village and College Libraries.

Agriculture

Lists of publications of great practical use to the farmer, stockman, and poultryman are on an adjoining bulletin board. The bulletins on these lists are published by the United States Department of Agriculture, the Massachusetts Agricultural Experiment Station at Amherst; the New York State Agricultural Experiment Station at Ithaca, and the Connecticut Agricultural Experiment Station at Storrs.

Collections and Objects of Local Interest

The sword and other personal property of Ephraim Williams, the founder of Williams College. In the College Library.

Collections of local rocks and other exhibits. In the Geological Museum, Clark Hall.

Mission Monument, Mission Park.

Block House Marker, West Main Street, on the property of the Kappa Alpha House.

The desirability of such a list in every post-office in the land becomes greater as automobile travel becomes more general. (In one

state there is, on an average, one automobile for every six persons.) Farmers, who, a few years ago, seldom went further than their nearest town now go many miles in their automobiles. When they reach a town new to them they want to see whatever is of interest. If all automobilists and other travelers knew a list such as the above could be found in the post-office they would first go there for information.

There is another important reason why such lists should be on exhibition in post-offices. It is very desirable that some person or persons in every community should know what has been written about their region. If those government and state publications pertaining to a region were listed and on sale at the post-offices, the postmasters and their assistants would know about them and through them this knowledge, which at present is confined to comparatively few, would be disseminated.

All this could be accomplished if congress should pass the following laws:

1. A law ordering the exhibition of a list of the publications pertaining to the region in which the post-office is situated, of somewhat the same character as that for Williamstown, Massachusetts.

2. A law ordering the scientific bureaus to send to each first, second, and third class post-office all of the government publications of local interest, and directing the postmasters to offer them for sale.

3. A law ordering that state publications be offered for sale by the postmasters if the state legislatures so direct.

It is hoped that all scientists and others interested will write to their congressmen urging the enactment of such a law as that outlined above so that our excellent government and state publications may become better known and so that our post-offices may become centers of greater usefulness.

Herdman F. Cleland

SCIENTIFIC EVENTS

THE INSTITUTE OF HUMAN PALEONTOLOGY

On December 23, 1920, the Institute of Human Paleontology in Paris was formally declared open by Prince Albert of Monaco, its founder. The account in *Nature* states that the institute is situated in the Boulevard Saint Marcel. The building, which was nearing completion when war broke out, contains a large amphitheater for lectures and meetings, a spacious library, and a number of rooms fitted up as laboratories, for examining and photographing the material furnished by excavation. Collections of specimens from the sites which have already been explored, as well as reproductions of the paintings and drawings found on the walls of the French and Spanish paleolithic caves, are exhibited in the building. An endowment of two million francs is attached to the Prince of Monaco's foundation, and an additional sum has been promised should it be rendered necessary by any further increase in the cost of living. The institute is under the direction of M. Marcelin Boule, assisted by a council consisting of MM. Salomon Reinach, Dislère, Verneau and Louis Mayer.

Among those who were present at the opening ceremony were the President of the French Republic, M. Millerand, H.I.H. Prince Roland Bonaparte, M. Honnorat, then Minister of Public Instruction, the Belgian and Italian Ambassadors, the Argentine and Persian Ministers, M. Lacroix, secretary of the Academy of Sciences, the president of the Academy of Medicine, and representatives of the College of Medicine, the Collège de France, the Pasteur Institute, and the various scientific societies. An inaugural address was delivered by the Prince of Monaco, who defined the broad aims of human paleontology. At the conclusion of the prince's address brief speeches were made by M. Honnorat, minister of public instruction, M. Perrier, and M. Le Corbeiller, president of the Municipal Council, the last named speaking on behalf of the city of Paris. Lastly, M. E. Cartailhac, the veteran archeologist, expressed his joy at the creation of the institute, which, he said, had been his dearest wish throughout his career as an archeologist.

A NEW CANADIAN AGRICULTURAL JOURNAL

The problems of technical agriculture in the adjoining provinces of Canada are essen-

tially the same as those of the northern states of this country. Anyone who has taken the trouble to familiarize himself with the situation can not fail to be impressed with the similarity of aims and ideals in agricultural investigation and education in Canada and the United States. The workers in technical agriculture are responsible for much of the recent progress and prosperity of Canada. This is perhaps most appreciated in this country by those of us who are engaged in similar lines of work in the northern states and who, through correspondence and frequent conferences upon mutual problems with our colleagues in adjacent provinces, are best informed as to the results they have accomplished and the progress that they are making. Therefore the writer feels that a new agricultural journal, the official organ of the Canadian Society of Technical Agriculturists, will be welcomed and will find many readers on this side of the international boundary.

The first issue of *Scientific Agriculture and La Revue Agronomique Canadienne* bears the date of January 1, 1921. It is published monthly by the Industrial and Educational Publishing Company, Ltd., Gardenvale, P. Q. The title page states that it is: "A magazine devoted to the general advancement of agriculture in Canada. Published in the interests of agricultural science and research." The aims of the journal are set forth in more detail in the following quotation from the inital editorial.

> As the official organ of the Canadian Society of Technical Agriculturists, our columns will naturally give publicity to the work which that organization is doing. The articles published will, as far as possible, treat with the educational, scientific and more progressive phases of agricultural effort. Certain pages will perhaps appear to be of primary interest to members of the C. S. T. A., but the general reader will find much information in those pages that is of equal interest to him.
>
> We particularly desire to cooperate with the present existing agricultural press, and to assist them in any way possible. We do not intend to be competitive, nor to trespass severely upon the ground which they are already covering. We feel, however, that there is a place for a magazine which can represent technical agriculture in this country and we feel certain that no existing publication will dispute that claim, or hesitate to welcome this venture.

As the name of the publication suggests, articles will be printed both in English and French.

Warner J. Morse

Maine Agricultural Experiment Station,
Orono, Maine

SCIENTIFIC LECTURES AT THE UNIVERSITY OF MINNESOTA

The following program of Sunday lectures is being given at the Zoological Museum of the University of Minnesota:

January 2. "The winter bird-life of Minnesota." By D. Lange, principal of the St. Paul Mechanic Arts High School.

January 9. "The geology of the Minnesota iron ores." By W. H. Emmons, professor of geology, University of Minnesota.

January 16. "The work of the state game and fish commissioner." By Carlos Avery, game and fish commissioner of Minnesota.

January 23. "The story of the wheat rust." By E. C. Stakman, professor of plant pathology, University of Minnesota.

January 30. "Animal pets and their relation to health." By W. A. Riley, professor of entomology, University of Minnesota.

February 6. "Some Minnesota butterflies and moths and the mystery of their double lives." By Royal N. Chapman, assistant professor of animal biology, University of Minnesota.

February 13. "The work of the chief state forester." By Wm. T. Cox, chief forester of Minnesota.

February 20. "The mysteries of pond life." By C. P. Sigerfoos, professor of zoology, University of Minnesota.

February 27. "The Indians of Minnesota: past and present." By A. E. Jenks, professor of anthropology, University of Minnesota.

March 6. "Itasca state park and its wild life." By Thos. S. Roberts, director of the zoological museum, University of Minnesota.

March 13. "Living lanterns of fireflies and other animals." By E. J. Lund, associate professor of animal biology, University of Minnesota.

March 20. "Our spring flowers." By N. L. Huff, assistant professor of botany, University of Minnesota.

March 27. "The home-coming of our birds." By Thos. S. Roberts, director of the zoological museum, University of Minnesota.

THE MARSH FUND OF THE NATIONAL ACADEMY OF SCIENCES

At his death in 1899 Professor O. C. Marsh left to the National Academy of Sciences a sum slightly in excess of $7,000, the income from which was to be used for support of researches in natural history. By reason of judicious handling, the principal and interest now amount to more than $20,000, and the income is made available to the Committee on the Marsh Fund for grants in accordance with the original purpose of the bequest. At its last annual meeting the National Academy approved the following recommendations of the Committee on the Marsh Fund, namely:

> That in general the income be used for important pieces of constructive, scholarly work within the field of science to which Professor O. C. Marsh gave his principal effort. It seems appropriate that grants in the first instance should be used for the support of paleontological and geological research, and that beyond this field the committee should next consider research in aspects of biology related especially to paleontology.

The interest on the Marsh Fund available for the coming year will make possible grants totaling approximately $1,500. The committee deesires to make the allotments in such a manner as to contribute most definitely to the advance of constructive work in the subject to which Professor Marsh dedicated this gift.

Suggestions as to the best utilization of funds will be appreciated. Proposals made may take the form of recommendations regarding problems to be solved, or may concern individuals or organizations guaranteeing through their work the type of constructive effort to which the support of this fund might well be given.

Applications or recommendations should be forwarded to the secretary of the National Academy of Sciences, Smithsonian Institution, Washington, D. C., on or before April 5, 1921.

John C. Merriam, *Chairman,*
Marsh Fund Committee

THE ELECTION OF DR. ANGELL AS PRESIDENT OF YALE UNIVERSITY

The Yale Corporation at its adjourned meeting on February 20 by unanimous vote elected James Rowland Angell as president of the university to succeed Arthur Twining Hadley at the close of the present university year. While the decision was reached last week, no formal action was taken until it was ascertained that Dr. Angell could accept. The Corporation has endeavored to choose for its head the ablest educational administrator available in the United States, irrespective of the college of his graduation or the place of his residence.

Dr. Angell is a son of the late President Angell of the University of Michigan, a graduate of that university of the class of 1890, and as professor at the University of Minnesota, professor, dean and acting president of the University of Chicago, chairman of the National Research Council, and president of the Carnegie Corporation, he has shown ability as an administrator and as an educational leader. Dr. Angell is a distinguished psychologist, having been president of the American Psychological Association and being a member of the National Academy of Sciences. Dr. Angell gave the Thomas Lecture to freshmen at Yale this year and was sought for by Yale several years ago for a chair in the Department of Philosophy and Psychology.

The election of Dr. Angell to the Presidency of Yale comes as a result of ten months of study on the part of the Corporation to decide on the strongest man in America for the position. President Hadley submitted his resignation April 10, 1920, and a committee was appointed to receive names of possible candidates for the office of president and to transmit them to the Corporation. In this way some eighty names have been under careful consideration. The Corporation believes "that no one in America combines the breadth of educational experience, and busines ability, high public service and spiritual ideals more completely than Dr. Angell. He has also shown during his many years of

service at the Universities of Minnesota and Chicago a rare capacity for sympathetic understanding of undergraduate life."

President-elect Angell is now in the south. It is expected that he will later make regular visits to confer with members of the faculty and familiarize himself with the Yale situation.

SCIENTIFIC NOTES AND NEWS

AT the annual meeting of the trustees of the American Museum of Natural History changes in the scientific staff were announced as follows: Dr. J. A. Allen, former curator of mammals, was made honorary curator of mammals; Dr. Henry E. Crampton, former curator of invertebrate zoology, was made honorary curator, and Dr. Willard G. Van Name was made assistant curator of lower invertebrates; Dr. F. E. Lutz, former associate curator of invertebrates, was made curator of entomology; Dr. Robert Cushman Murphy, former curator of the department of natural science at the Brooklyn Museum, was made associate curator of marine birds; Mr. Carl E. Akeley was made associate in mammalogy; Dr. J. Howard McGregor, of Columbia University, was made research associate in human anatomy; Mr. E. W. Gudger was made an associate in ichthyology. A new department was formed, to be known as the department of comparative anatomy, of which Dr. William E. Gregory and Mr. S. H. Chubb, both previously of the museum's staff, were made curator and assistant in osteology, respectively.

AT the Charter Day Exercises of the University of Pittsburgh on February 18, the honorary degree of doctor of laws was conferred upon Mr. William Boyce Thompson, the copper industrialist of New York, N. Y. On the same occasion the honorary degree of doctor of science was conferred upon Mr. C. H. MacDowell, president of the Armour Fertilizer Company and director of the chemicals division of the War Industries Board during 1918. These honors were given upon the recommendation of the Mellon Institute of Industrial Research.

DR. A. F. BLAKESLEE, of the department of genetics of the Carnegie Institution of Washington, has been elected an associate member of the Royal Botanical Society of Belgium.

THE American Genetic Association has awarded the Frank N. Meyer medal on Dr. Trabut, a botanist who is a member of the faculty of the University of Algiers.

MR. LLEWELLYN TREACHER has been selected for the Foulerton award of the Geologists' Association.

AT the annual general meeting of the Faraday Society, London, the following officers were elected to serve for the coming year: President, Professor A. W. Porter; Vice-presidents, W. R. Cooper, Professor C. H. Desch, Dr. J. A. Harker, Emil Hatschek, Professor T. M. Lowry, Dr. E. H. Rayner and Dr. G. Senter.

LAWRENCE WILKERSON WALLACE was elected secretary of American Engineering Council at the meeting of the executive board in Syracuse, N. Y., on February 14, succeeding L. P. Alford, of New York, who has been acting secretary since the formation of the council on November 19, 1920.

AT the meeting of the board of trustees of the American Medical Association held on February 5, the following fellows were reelected for terms of six years to positions on the editorial boards of the special journals published by the association as indicated: Richard C. Cabot, Boston, *Archives of Internal Medicine;* John Howland, Baltimore, *American Journal of Diseases of Children;* Samuel T. Orton, Iowa City, Iowa, *Archives of Neurology and Psychiatry;* Martin E. Engman, St. Louis, *Archives of Dermatology and Syphilology.* E. S. Judd, Rochester Minn., was elected to the editorial board of the *Archives of Surgery,* succeeding Dr. William Mayo, who had resigned.

AT the "Utility Corn Show" held at Galesburg, Ill., January 5 and 6, Mr. J. R. Holbert, agronomist, Office of Cereal Investigations, U. S. Department of Agriculture, was presented with a silver loving cup inscribed:

"Awarded to J. R. Holbert in recognition of unselfish devotion to study of corn diseases."

Dr. J. D. Morgan, Ph.D. (Columbia '16) has been appointed clinical psychologist in charge of the psychology clinic in the department of philosophy and psychology, and psychologist at the psychopathic hospital of the University of Iowa. Dr. Morgan is at present stationed in the Hawaiian Islands engaged in army hospital reconstruction work.

Charles F. Farmer, assistant professor in the school of forestry at the Montana State University at Missoula, has resigned to take a position with a Tacoma wood pipe company.

Dr. Margaret C. Ferguson, professor of botany at Wellesley College, and chairman of the department, has leave of absence during the present year and sailed for Australia and New Zealand on January 25 after spending the last six months in California, devoting most of her time to research work.

Dr. Wilder G. Penfield, of Princeton, has received a Beit fellowship. He will make researches in the pathological development of medical science in England during the coming year.

Dr. Raymond F. Bacon, director of the Mellon Institute of Industrial Research of the University of Pittsburgh, has returned from Europe where he spent the holidays in France and Italy in the investigation of nitrogen-fixation processes.

Sir Francis Younghusband, president of the Royal Geographical Society, announced at the meeting of the society on January 24 that the chief of this year's expedition to Mount Everest will be Colonel Howard Bury, while the actual reconnaissance of the mountain will be in the charge of Mr. Harold Raeburn, who will leave England for India in March.

We learn from *Nature* that in cooperation with the Anglo-Batavian Society, the University of London has made arrangements for an interchange of lectures on medical subjects between London and the Netherlands. The first lecture of the series to be given by Dutch professors was delivered by Professor Wertheim-Salamonson, of Amsterdam, on January 17 at the Royal Society of Medicine, on "Tonus and reflexes." The second lecture was given by Professor Boeke, of Leyden, on February 16.

At the meeting of the Royal Society on March 3 a discussion on isotopes will be opened by Sir J. J. Thomson.

Professor W. F. G. Swann, of the University of Minnesota, gave to the undergraduate students of Northwestern University on February 16, "A popular account of Einstein's theory of relativity." In the evening of the same day he lectured before the Graduate Club of Northwestern University upon "Some unsolved problems in cosmical physics."

The Galton anniversary meeting was held in London on February 16. The Galton lecture, preceded by a dinner, was given by Dr. W. Bateson, on "Common sense in racial problems."

Mrs. Fredonia Johnston Pratt, of St. Louis, Mo., widow of the late Dr. David S. Pratt, assistant director of the Mellon Institute of Industrial Research of the University of Pittsburgh, has established in that institution an industrial fellowship as a memorial to Dr. Pratt. The incumbent of this industrial fellowship will conduct research in that field of organic chemistry in which Dr. Pratt was especially interested.

Professor Irving Angell Field, head of the department of biology at Clark University since 1918, died on February 14 at his home in Worcester.

We learn from *Nature* that Dr. John Beattie Crozier, author of works on intellectual and social development, died in London on January 8. He was born in Canada in 1849.

Frédéric Houssay, professor of zoology at the Sorbonne and dean of the faculty of science, has died at the age of about sixty years.

Carl Toldt, professor of anatomy at Vienna, has died at the age of eighty years.

We learn from the *Journal* of the American Association that as a memorial to the late

General W. C. Gorgas and in recognition of his achievements in preventive medicine, Dr. Belisario Porras, president of the Republic of Panama, has proposed the foundation of an institute of tropical and preventive medicine in connection with the Santo Tomás Hospital at Panama. Pending the erection of a permanent building it is planned that the institute shall comprise a well-organized laboratory for research in tropical diseases in the Santo Tomás Hospital. After the laboratory has been established it is contemplated to organize a school of tropical medicine. As it is the wish of President Porras that the institute be a contribution of the Republic of Panama to the memory of General Gorgas, the project will be financed by the Panamanian government. Although the work of the institute will be largely in the interests of the countries of Central and South America, it is hoped that its activities will give it an international scope and that it will have the active cooperation of leaders in tropical and preventive medicine. At a meeting held in Washington, January 31, a provisional board of directors for the United States was appointed, including Admiral William C. Braisted, M. C., U. S. Navy, chairman; Dr. Leo S. Rowe, director of the Pan-American Union; Surgeon-Generals Ireland, Stitt, and Cumming of the Army, Navy and Public Health Service, respectively; Hon. J. E. Lefevre, chargé d'affaires of the Republic of Panama, in Washington, and Hon. John Bassett Moore, legal representative. A similar board will be named to represent the countries of Central and South America.

UNIVERSITY AND EDUCATIONAL NEWS

THE Smith-Towner bill, creating a Department of Education and providing federal aid to the states for the promotion of education, has been favorably reported by the House Committee on Education.

THE first Congress of the Universities of the British Empire was held in London in 1912 when all, to the number of fifty-three, were represented. It was decided to hold the congresses every five years, but the war made it impossible to do so in 1917. The second congress will accordingly be held in the summer of 1921. The number of British universities has in the meantime increased to fifty-eight. From July 5 to 8, the representatives will be entertained by Oxford University.

PROFESSOR C. E. HORNE, of the University of Porto Rico, has been appointed dean of the college of agriculture and mechanical arts at the University of Mayagüez, P. R.

RICHARD HAMER, M.A. (Toronto), formerly assistant professor of physics at the Carnegie Institute of Technology, Pittsburgh, has accepted a Whiting fellowship at the University of California where he is now engaged in research on the "Photo-electric effect."

PROFESSOR FRANK LINCOLN STEVENS, of the University of Illinois, has been appointed Bishop Museum fellow at Yale University for the next university year. Dr. Oskar Baudisch, formerly of the University of Zurich, has been appointed research associate in the university for next year on the recommendation of the department of chemistry, approved by the board of permanent officers of the graduate school. Dr. Baudisch's publications include "The assimilation of inorganic nitrogenous compounds by plants," "The theory of color lakes" and "Complex iron salts."

DISCUSSION AND CORRESPONDENCE

ON A BOTTLE WHICH DRIFTED FROM THE GULF OF MAINE TO THE AZORES

IN a previous note[1] the writer has referred to certain drift-bottles set out in the Bay of Fundy for the purpose of investigating the movements of the water there. Some of these bottles were found on the shores of the Gulf of Maine and indicated by their drift a superficial circulation of the water in the Gulf. Since writing the note one of the bottles set out last year off the coast of New-Brunswick has been returned from the Azores. The bottle was set out on August 29, 1919, one mile southeast of Point Lepreaux on the New

[1] SCIENCE, N. S., Vol. LII., No. 1349, November 5, 1920, page 442.

Brunswick coast (Lat. 45° 3′ N., Long. 66° 28′ W.) and was found on August 8, 1920, on the shore at "Ponta Delgada, Flores, Azores" (apparently Delgada Point of the Hydrographic chart, Lat. 39° 31′ N. Long., 31° 13′ W., and not Ponta Delgada, San Miguel). Flores is one of the northwestern islands of the Azores and Delgada Pt. is its northmost point. It would therefore seem from the position in which the bottle was found that it had approached the Azores from the north or northwest. The bottle was of heavy glass and closed with a paraffined cork. It contained a Canadian postcard, offering a reward to the finder who wrote on it the time and place of finding. Set out at the same time were 99 other similar bottles and they were set out in a line from Point Lepreaux to Gulliver Hole, on the Nova Scotia Coast. A bottle set out about a mile away from the one found in the Azores was picked up on Cape Cod.

From the known drift of other bottles in the Gulf of Maine it seems probable that the bottle which was returned from the Azores passed southwestward in the Gulf of Maine and passed Cape Cod into the Atlantic and further that the bottle took about two and one half months to reach the water near Cape Cod. Without doubt the bottle encountered the "Gulf Stream" and was carried across it to its eastern and southern side as the "Gulf Stream" swings round the North Atlantic. The time taken by the bottle to go from the American coast to the Azores was probably not more than nine and one half months.

It is interesting to compare the drift of this bottle with that of one recorded in the *Toronto Daily Star*, November 1, 1920.[2]

> A bottle cast into the Atlantic Ocean near Newfoundland by Sergeant D. McInnes, of Edmonton, when returning to Halifax, September, 1919, after shooting at Bisley, reached Nieuport, Belgium, last August.

This bottle undoubtedly traveled in the western and northern edge of the "Gulf Stream" and took about the same time to cross as the other bottle.

The drift of these bottles may be further compared with the drift of derelicts[3] in the North Atlantic and especially with the well-known drift of the schooner *Fannie E. Wolston* which was adrift for at least two and a half years and was observed over thirty times. She was observed at sea in Lat. 36° N., Long. 74° W. (northeast of Cape Hatteras) on December 15, 1891, and four times afterwards on her way across the Atlantic in an easterly direction until she reached Lat. 35° N. and Long. 39° W. on June 13, 1892, having drifted in the six months about four fifths of the way from the American coast to the Azores. After reaching this point she circled in the Saragasso Sea and returned by a southern route to the American coast.

James W. Moor

Union College,
Schenectady, N. Y.

[2] For this citation the writer is indebted to Miss Rigby of the staff of the Atlantic Biological Station.

[3] "Wrecks and Derelicts in the North Atlantic Ocean," 1894, U. S. Hydrographic Office.

AN ADJUSTABLE EMBOUCHURE

To the Editor of Science: I am much interested in Professor Barus's article on "An Adjustable Embouchure" (which the types have made "embouchuer") appearing in Science for January 14, which has just come to hand. I think he did not see my instrument, exhibited at the meeting of the National Academy of Sciences and at the meeting of the American Physical Society in 1919, which I less modestly called "an artificially played brass instrument," and which I claimed worked exactly upon the principle of the human lips. except that it lacked their softness. In it a light piston, like a safety valve, with mass like the lips, was lifted from its seat by the air pressure, letting a puff of air into the wind instrument, while the potential energy (elasticity of the lips) was furnished by a wire under adjustable tension. The pulse being reflected at the mouth of the horn (see my paper in *Proc. Nat. Acad. Sci.*, July, 1919) comes back, and if it arrives in the right place,

the vibration is maintained. It also plays under water!

I have written out the theory, which under a certain assumption, shows that the sound can not be simple harmonic, though periodic. Pursuing the subject farther, I find that the problem leads to an integro-differential equation of a new type, and non-linear. Being in Paris in the summer of 1919 I wrote it out in French, hoping to present it to the Académie des Sciences, but took the precaution to show it to M. Hadamard. When he saw it he threw up his hands and exclaimed, "Vous avez résolu cela?" I replied, "Non, mais je l'ai posé," bearing in mind one of his papers where he had said that a problem was half solved when it was "bien posé." I thought I deserved some credit for that. So there it rests, half (or less) solved. If any of your readers think they can solve it, I am willing to divide the profits, or κῦδος, with them.

I am also indebted to Professor Barus for the word "siffling," which I had thought a Gallicism, but find that it is used by Chaucer.

Arthur Gordon Webster

Clark University,

VARIATION IN TARAXACUM

To the Editor of Science: Since several species of *Taraxacum* are parthenogenetic and at the same time highly variable they have looked like tempting material for the study of certain phases of genetics. Moreover their "polymorphy," as well as that of other parthenogenetic plants, has served as a partial basis for well-known attempts to explain parthenogenesis as due to hybridization.

As a matter of fact the degree of leaf dissection is correlated with the age of a given rosette. The typical seedling leaf in both of our common species (*T. vulgare*, gray-fruited, and *T. lævigatum*, red-fruited) tends to be entire and smooth, with the plant producing more dissected, and often more hairy, leaves as it grows older. This would have been obvious to students of the genus but for the confusing fact that smooth, entire leaves are often found on very old roots. If such cases are examined, however, it will be found that the apparently juvenile leaves are borne on multicipital branches of tender age.

It is of course well known that the vigorous production of blossoms after the second year causes a radial splitting of the root crown in seedling plants and the production of several daughter rosettes upon the parent root. This cleavage may extend through the length of the root and produce a number of distinct individuals, but in any case the daughter rosettes repeat the history of the parent seedling rosette, so far as leaf characteristics and blooming habits are concerned. If the newly split crown has been buried, the daughter rosettes will be produced at the end of typical rhizomes, often as much as six inches in length. Subsequent pressure renders these rhizomes quite root-like.

The above considerations clarify the interesting results of a culture experiment reported by Stork[1] It is, moreover, not unprofitable from the standpoint of taxonomy to inspect the average herbarium collection of *Taraxaca* while bearing in mind the correlations just pointed out.

Paul B. Sears

University of Nebraska

SCIENTIFIC BOOKS

Pharmaceutical Botany, A Text-book for Students of Pharmacy and Science. Third Edition. By Heber W. Youngken, A.M, M.S., Ph.M., Ph.D., Professor of Botany and Pharmacognosy, Philadelphia College of Pharmacy. P. Blakiston's Son & Co., Philadelphia. 1921. Pp. xix + 479. 238 illustrations and glossary.

This third edition of Dr. Youngken's excellent text-book has all the satisfactory points of the two preceding editions together with an enhanced value to teachers of the subject on account of the extensive improvements made in it. By reason of its adoption as a text in many academic institutions in addition to its very general use in the pharmacy schools, the author has followed the tendency already expressed in the second edition of making it more suitable for general botanical

[1] *Bull. Torr. Bot. Club*, 47: 199–210, 1920.

courses. The book is concise in its presentation of the subject and logical in its arrangement, it supplies exactly the need for a text in a short semester course in botany. It also lends itself well to expansion, as the reviewer has used the earlier editions, by means of supplemental lectures on the evolutionary development of plants, genetics, etc., and laboratory exercises.

This new edition has an increase of ninety pages and forty-three new illustrations have been inserted; adequate illustration is a most important feature in a scientific text-book. Chapter I. has been greatly extended so as to cover the chief methods of microtechnique. This is a practical aid to the student if a laboratory course is given in conjunction with the text-book work. Chapters II. and III. dealing with the alternation of generations and the life histories of the fern and pine, are essentially the same as in the preceding editions except that the illustrations are better, especially the reproductions of the microphotographs of sections. In Chapter IV. the treatment of the angiosperms, with *Erythronium* as a type, is expanded and additional illustrations inserted. Chapter V. entitled Vegetable Cytology is comprehensive to a degree. Mitosis and the morphology of a plant cell are adequately presented as well as a discussion of the modes of reproduction in plants. The section dealing with non-protoplasmic cell contents is especially detailed for such a general text and treats admirably the principal plant products as sugars, starches, glucosides, alkaloids, oils, gums, pigments, etc., with short tests for identifying specific substances as cocaine, veratrine, asparagine, caffein, salicin, hesperidin, etc., which supplies the needs of pharmacy students in this respect and emphasizes the economic importance of many plants for the general student.

While in its use as a general text it may be rather deficient in the presentation of botanical physiology an attempt is made in this edition to overcome this criticism by a discussion, under the head of Protoplasm and its Properties, of the elements of organic function. Various tropisms are considered and reference is made to the recent work of Steckbeck on sensitive plants. Chapters VI. and VII. represent the histological and anatomical section of the book. The treatment of plant tissues and organs, as roots, stems leaves, flowers, is thorough and complete, and while remniscent of that old and useful general text, Gray's Lessons in Botany, is quite modern in its presentation. The concluding Chapters VIII. and IX. cover the subjects of taxonomy and ecology. The latter subject is presented in four pages but the chapter on classification is very complete with regard to plants used in materia medica. Only the medicinal plants of each order or family are considered, the official name, the botanical name, the part of the plant used and the habitat being given in each case. The illustrations of these plants are especially helpful. If, however, the book is used as a general text a regular manual or flora could easily be substituted as a reference for that portion of the course in lieu of this pharmaceutical taxonomy.

Although the book was primarily written for pharmacy students, and is used by the reviewer for such students, the broad scope and the diverse phases of botanical science presented in a convenient and orderly manner commend it equally well to teachers as a general text.

H. H. M. Bowman
Department of Biology,
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SPECIAL ARTICLES

TWO LIMESTONE FORMATIONS OF THE CRETACEOUS OF TEXAS WHICH TRANSGRESS TIME DIAGONALLY

Some thirty-five years ago the existence of two great series of Cretaceous formations in the Texas region was pointed out by the writer, and it was shown that each of these—the Gulf and the Comanche Series—represented a cycle of sedimentation which culminated in relatively deeper water formations, known now as the Edwards Limestone and Austin Chalk respectively.

Observations of the past few years during

which I have been permitted to return to Texas and renew the studies of these formations, have shown that the lithologic aspect of each instead of representing definite and fixed time positions in their horizontal extent, moves upward through the geological column as it is respectively traced east or west from the locality of the standard section in Central Texas, as is shown on the accompanying diagram table. The position of the Austin Chalk ascends to the eastward from Central Texas towards northeast Texas and Arkansas, where it is known as the Anona Chalk, and Alabama, where it is called the Selma.

The Austin Chalk in the course of this ascent practically continues from the Niobrara to the Ripley or near Fox Hills stage of the time column, and is accompanied by corresponding changes in its fauna. This transgression of the Austin Chalk has recently been noted by my associate Mr. J. E. Brantly in a recent report on the oil fields of Alabama, published by the State Geological Survey of that state.

Recently while studying the geology of the Fort Stockton Country in Pecos County, Texas, the writer observed a similar instance of transgression by the Edwards limestone. In this instance both the lithologic and paleontologic facies of the Edwards limestone formation, which occupies a fixed position in the geologic column in Central Texas, is found to have transgressed through time diagonally until it occupies a higher and altogether different one in the vicinity of Fort Stockton, as it is traced to the westward from Austin towards the east front of the Cordilleran Ranges. This formation in both localities largely consists of cellular and semichalky white limestones which weathers gray and yellow, accompanied by a characteristic fauna of fossil species (Rudistes, corals, echinoderms, etc.).

In the typical Central Texas section heretofore described the Edwards limestone and its fauna occur in a definite position below the Kiamitia and Duck Creek formation. In the vicinity of Fort Stockton where it occurs as the cap rock of extensive areas, it was

DIAGONAL TRANSGRESSION OF THE EDWARDS LIMESTONE AND AUSTIN CHALK

Edwards Limestone					Time	Austin-Anona Chalk		
Locality						Locality		
Mexico	Stockton	Crockett	Austin	Fort Worth		Central Texas	N.E. Texas, Louisiana, Arkansas	Alabama, Mississippi
					Gulf Series, Navarro-(Ripley)			×
					Taylor-(Pierre)		×	
					Austin-(Niobrara)	×		
					Eagle-Ford (Benton)			
					Woodbine (Dakota)			
					Comanche-Series, Buda			
					Del Rio			
		×			Georgetown			
					Duck Creek			
					Kiamitia			
				×	Goodland			
					Walnut			
					Paluxy			
					Glen Rose			
					Trinity			

found with the same lithologic aspects and fauna as in Central Texas, but its stratigraphic position was found to be above the Georgetown Duck Creek and Kiamitia formations and faunas, instead of below them, as it normally occurs in the Central Texas sections.

The only hypothesis I have to offer for these peculiar conditions is that during the two epochs similar conditions of depth and environment must have continued with shifting location as time progressed, but at present I can not explain why the fauna of the Austin-Anona Chalk changed with this transgression while that of the Edwards persisted.

This fact may have important bearing upon the correlation of the Texas Cretaceous sections with those of Mexico, and assist in the interpretation of the as yet but little understood formations of the latter county.

ROBERT T. HILL

DALLAS, TEXAS

THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-seventh annual meeting of the society was held at Columbia University on Tuesday and Wednesday, December 28–29, with the usual

morning and afternoon sessions on each day. The attendance included 86 members. President Frank Morley occupied the chair, relieved by G. D. Birkhoff, R. G. D. Richardson, and H. S. White. The following new members were elected: Professor L. M. Coffin, Coe College; Professor I. H. Fenn, Polytechnic Institute of Brooklyn; Dr. Ludwik Silberstein, Eastman Kodak Company; Dr. W. L. G. Williams, Cornell University. One hundred and twenty-one applications for membership were received.

At the annual election the following officers and other members of the council were chosen: President, G. A. Bliss; vice-presidents, F. N. Cole and Dunham Jackson; secretary, R. G. D. Richardson; treasurer, W. B. Fite; committee of publication, E. R. Hedrick, W. A. Hurwitz, J. W. Young; members of the council to serve until December, 1923, T. H. Gronwall, O. D. Kellogg, Florence P. Lewis, A. D. Pitcher.

The total membership of the society is now 769, including 87 life members. The total attendance of members at all meetings, including sectional meetof papers read was 211. The number of members attending at least one meeting during the year was 280. At the annual election 189 votes were cast. The treasurer's report shows a balance of $8,994.53, including the life membership fund of $7,518.87. Sales of the society's publications during the year amounted to $2,067.74. The library now contains 5,862 volumes, excluding some 500 unbound dissertations.

At the meeting of the council, Professor T. S. Fiske, as representative of the contributors to the Bôcher memorial fund, tendered the fund to the society to be held in trust and the income to be employed for the advancement of mathematical science. The trust was accepted, and a committee appointed to consider the most appropriate use to which the income of the fund could be devoted.

A committee was appointed to make the necessary arrangements for the meeting of the society to be held at Wellesley College in the summer of 1921.

The afternoon session on Tuesday was especially marked by the retiring presidential address of Professor Frank Morley, on "Pleasant questions and wonderful effects." A dinner was held at the Faculty Club Tuesday evening at which fifty members were present.

At the close of the morning session on Wednesday, Professor H. S. White, in a short address, tendered the thanks of the society to Professor Cole for his distinguished services during his twenty-five years of office as secretary of the society and editor of its *Bulletin*.

The following papers were read at the annual meeting:

C. E. Wilder: "Einstein's four-dimensional space is not contained in a five-dimensional linear space."

J. L. Walsh: "On the convergence of the Sturm-Liouville series."

Anna M. Mullikin: "Certain theorems concerning connected point sets."

A. R. Schweitzer: "On homogeneous functions as generators of an abstract field."

A. R. Schweitzer: "The concept of an iterative compositional algebra."

Joseph Lipka: "Transformations of trajectories on a surface."

Harry Langman: "Conformal transformations of period n and groups generated by them."

O. E. Glenn: "On a new treatment of theorems of finiteness (second paper)." (Preliminary report.)

J. E. Rowe: "The efficiency of projectile and gun."

S. D. Zeldin: "On the structure of finite continuous groups with one two-parameter subgroup."

S. D. Zeldin: "On the structure of finite continuous groups with a finite number of exceptional infinitesimal transformations."

H. S. Vandiver: "On quadratic congruences and the factorization of integers."

E. V. Huntington: "A mathematical theory of proportional representation."

H. M. Morse: "Recurrent motions of the discontinuous type."

Frank Morley: presidential address: "Pleasant questions and wonderful effects."

Edward Kasner: "Properties of orbits in the general theory of relativity."

Edward Kasner: "The solar gravitational field in finite form."

Norbert Wiener: "The average of an analytic functional."

Norbert Wiener: "The average of a functional."

Norbert Wiener: "Further properties of the average of a functional."

Gillie A. Larew: "The Hilbert integral and Mayer fields for the problem of Mayer in the calculus of variations."

R. M. Mathews: "Generalizations of the classical construction of the strophoid."

W. A. Hurwitz: "Some properties of methods of evaluation of divergent sequences."

W. C. Graustein: "Parallel maps of surfaces."

J. H. M. Wedderburn: "On the maximum value of a determinant."

J. H. M. Wedderburn: "On the automorphic transformation of a bilinear form."

J. W. Lasley, Jr.: "Some special cases of the flecnode transformation of ruled surfaces."

R. G. D. Richardson: "The theory of relative maxima and minima of quadratic and hermitian forms and its application to a new foundation for the theory of bilinear forms. First paper: Equivalence of pairs of bilinear forms."

J. S. Taylor: "The analytic geometry of complex variables with some applications to function theory."

C. H. Forsyth: "The value of a bond to be redeemed ultimately, both principal and interest, in equal installments."

C. H. Forsyth: "Valuation of bonds bought to realize a specified rate of interest assuming the amortizations to accumulate at a savings bank rate."

Einar Hille: "Zeros of Legendre functions."

W. B. Carver: "Systems of linear inequalities."

J. L. Coolidge: "Differential geometry of the complex plane."

C. L. E. Moore: "Note on minimal varieties in hyperspace."

I. J. Schwatt: "Independent expressions for the Bernoulli numbers."

I. J. Schwatt: "Relations involving the numbers of Bernoulli and Euler."

I. J. Schwatt: "Independent expressions for Euler numbers."

I. J. Schwatt: "Independent expressions for the Euler numbers of higher order."

I. J. Schwatt: "Summation of a type of Fourier's series."

F. W. Owens: "On the projectivity assumption in projective geometry."

R. W. Burgess: "On certain simple skew frequency curves."

G. M. Robison: "Divergent double series and sequences."

G. D. Birkhoff: "An extension of Poincaré's geometric theorem."

J. L. Walsh: "On the location of the roots of polynomials."

Abstracts of the papers will appear in the March issue of the society's *Bulletin*.

The fifteenth western meeting of the society was held at Chicago on December 29–30, in connection with the meeting of the American Association for the Advancement of Science. The next regular meeting of the society will be held at New York on February 26.

R. G. D. Richardson,
Secretary

THE AMERICAN ASTRONOMICAL SOCIETY

The twenty-fifth meeting of the society was held in affiliation with the American Association for the Advancement of Science at the University of Chicago on December 28–30, 1920. In common with other societies there was a full attendance of members, about sixty astronomers being present, and there were many interesting and valuable papers. Sessions were held on three days in the Ryerson Physical Laboratory, but without doubt the most important astronomical communication was presented at the joint session with the American Physical Society and the Optical Society of America, when Professor A. A. Michelson announced the striking success of his interferometer as applied at Mt. Wilson in the direct measure of the diameter of the star α *Orionis*.

The members attended a joint dinner at the Quadrangle Club with the members of the mathematical societies, and there was the usual profitable intercourse with other men of science made possible at these large gatherings.

As this was not the annual meeting of the society, there were no particular matters of business to be considered. A dozen new members were elected, bringing the total membership to something more than three hundred and fifty.

Following are the titles of the papers, abstracts of which will be regularly published in *Popular Astronomy*.

Note on the comparison of spectral types determined at Harvard and Mount Wilson: W. S. Adams and A. H. Joy.

Evidence regarding the giant and dwarf division of stars afforded by recent Mount Wilson parallaxes: W. S. Adams and A. H. Joy.

Additional evidence on changes of wave-length which are progressive with stellar type: Sebastian Albrecht.

Sun-spot intensities as components of a Fourier series: Dinsmore Alter.

The association of hydrogen lines with the "invariable" K line in the spectrum of κ Draconis: R. H. Baker.

Observations of the present disappearance of the rings of Saturn: E. E. Barnard.

Probable explanation of the apparent elongation of the Gegenschein: E. E. Barnard.

Comments on the spectra of Nova Cygni No. 3 and Nova Aquilae No. 3: S. B. Barrett and E. B. Frost.

The system of magnetic forces during the solar eclipse of May 29, 1919: Louis A. Bauer.

The light-curve of Nova Cygni No. 3: Leon Campbell.

Some new methods for double star orbits: G. C. Comstock.

An instrumental source of doubling of the emission lines in the spectrum of γ Cassiopeiae: R. H. Curtiss.

The search for the gravitational effect predicted by Einstein for solar wave-lengths: Ralph E. DeLury.

Second note on the displacements of spectrum lines at the limb of the sun: Ralph E. DeLury.

Further note on fluctuations in the moon's longitude in relation to meteorological variations: Ralph E. DeLury.

Some measurements of the displacements of spectrum lines in the penumbrae of sun-spots: Ralph E. DeLury and John L. O'Connor.

Notes on atmospheric conditions at Tucson, Arizona: A. E. Douglass.

Stellar parallaxes determined at the Dearborn Observatory: Philip Fox.

On some "irreconcilables" among stellar radial velocities: E. B. Frost.

Sundry spectroscopic binaries: E. B. Frost and S. B. Barrett.

Notes on Nova Cygni No. 3: W. E. Harper.

The spectroscopic orbit of Boss 5070: W. E. Harper.

The photographic light-curve of Nova Cygni No. 3: F. Henroteau.

The North America nebula: F. Henroteau.

Recent photographic observations of several well-known novae: C. O. Lampland.

Motions of the prominence of October 8, 1920: O. J. Lee.

Progress in the reduction of the Kapteyn zone at north declination 45°: O. J. Lee.

The Des Moines municipal observatory: D. W. Morehouse.

On the age of the stars: F. R. Moulton.

Orbit of the spectroscopic binary τ Cygni (period 3 h. 25 m.): J. Paraskevopoulos.

Objective prism spectra of Nova Aquilae No. 3 and Nova Cygni No. 3: J. A. Parkhurst and E. B. Frost.

The diameter of α Orionis by Michelson's interferometer methods: F. G. Pease.

The intensity distribution in tpyical stellar spectra: H. H. Plaskett.

The spectroscopic orbit and dimensions of Z. Vulpeculæ: J. S. Plaskett.

A wide-angle astronomical doublet: Frank E. Ross.

The Kostinsky effect: Frank E. Ross.

Comparative tests of the 100-inch and 60-inch reflectors: F. H. Seares.

Secular motion of perihelion due to the dragging of a compressible aether: L. Silberstein.

On some new variable stars: Joel Stebbins.

Spectrographic observation of rotating spiral nebulæ: V. M. Slipher.

Photographic distortion on eclipse plates and the Einstein effect: Frederick Slocum.

Chronographic measurement of small time intervals: R. Meldrum Stewart.

Recording of wireless time signals: R. Meldrum Stewart and J. P. Henderson.

Circle flexure of the Ottawa meridian circle: R. Meldrum Stewart and C. C. Smith.

Progress of the measurement of the Hussey double stars: G. Van Biesbroeck.

Note on the effect of the barometric gradient on meridian observations: C. C. Wylie.

On the probable reason why certain periodic comets have not been found on their predicted returns: Jessica M. Young.

The spectroscopic orbit of O Draconis: R. K. Young.

Joel Stebbins,
Secretary

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CONTENTS

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THE STRUCTURAL FAILURE OF THE LITHOSPHERE[1]

As a foundation for ordinary human activities it is but natural that the lithosphere or solid earth should be a popular symbol of strength and permanence; but the geologist sees abundant evidences that it has fared badly in the contest with environmental forces, past and present. It has been weak and incompetent; it has bent, crumpled, broken and mashed; structurally it has failed; in considerable part it now consists of structural ruins.

The problem of the structural geologist includes the restoration of these ruins and a determination of the conditions and causes of failure. His problem is not rendered easier by the fact that it is seldom possible to see the structures in three dimensions, and that he must base his restoration on fragments of evidence seen at the surface or on the very limited outlook of underground openings or on inferences from environmental conditions. Furthermore, the geologist seldom sees rock failure in actual progress. If he does he may not recognize it because the movement is so slow. He arrives after the disturbance is over and must infer the nature of the forces and processes from the results. In attempting to picture conditions in the inaccessible deep zones, he must make long range inferences from the few available facts.

The study of structural geology naturally begins with the mapping and description of separate structures like folds, faults, joints, and cleavage. Too often this has been regarded as the end and not as a step toward the understanding of the structural conditions as a

[1] Address of the retiring vice-president and chairman of Section E, the American Association for Advancement of Science, Chicago, December 28, 1920.

whole. The necessity of integrating evidence and information from scant observations requires an understanding of the interrelations of structures and of great group characteristics of a given environment or of a given kind of rock. I would like to comment briefly on some of these broader considerations, not exhaustively, and certainly not with full understanding, but with a view to indicating some of the salient facts now known and the manner in which these facts have been built into certain generalizations and hypotheses as to movements of the lithosphere.

I. STRUCTURAL FAILURE IN THE ZONE OF OBSERVATION

We may direct our attention first to the structural failure of rocks extending downward only a few miles from the earth's surface. The characteristics of this region are disclosed to us by deformed rocks, some of which were once far below the surface, but now brought within our range of observation by the erosion of overlying rocks. This may be conveniently referred to as our zone of observation.

Heterogeneous Nature of Movement.—In this zone, some of the rocks have been deformed by rock flowage and some by rock fracture, both kinds of deformation often resulting in folding and tilting of beds. By rock flowage we mean "solid," "plastic," "massive," or "viscous" movement under great containing pressures during which the rock and its constituent minerals retain their properties of elasticity and rigidity. No one of these descriptive terms may be technically accurate and comprehensive, but the movement partakes of the characters expressed by all of them. The movement is not necessarily slow and continuous; there is geologic evidence that it is periodic. Rock flowage is essentially characterized by the parallel dimensional arrangement of minerals, like mica and hornblende, developed by recrystallization during the process. These minerals are present abundantly after the process, not before. Rock flowage is intimately associated with fracture, including the minute granulation and slicing of mineral particles, and including larger fractures, especially of the shearing type. While rock flowage and rock fracture constitute two distinct types of deformation, there is almost complete gradation between the two, and much deformation is not accurately described by either term. A displacement may take place along a clean fracture, or along a fracture on which there has been local rock flowage, or along a zone of closely spaced parallel fractures with rock flowage affecting all of the intervening masses, or along a zone of rock flowage in which evidences of fracture planes are indistinct or altogether lacking. A single shear plane may show all of these features. In a large way a considerable zone of flowage may often be interpreted, in its relations to displacement and stresses, in much the same manner as a fracture plane.

The difficulty of a precise definition of the two phenomena of fracture and flow is well illustrated in the so-called flow accomplished experimentally. Shearing, thrust, granulation and slicing are here strongly in evidence, while the parallelism of mineral particles brought about through recrystallization, so conspicuous in schists, slates and gneisses, which are the principal evidence of rock flowage in nature, is almost lacking in the experimental results. Deformation induced artificially is plastic flow, but the same kind of deformation observed in nature is often called fracture. With a longer time factor the experimental flowage would presumably more closely approximate that of nature.

Structural failure within our zone of observation, whether by fracture or flow, has not been confined to any particular plane or formation, but is so distributed as to indicate that adjustment of rock masses under deforming stresses has been accomplished by movement in many zones, in many formations, in all directions, and with all inclinations. Rocks in this zone as a whole have not yielded to stresses as homogeneous masses. In fact, even down to comparatively small units of volume the rule is heterogeneity. No matter how homogeneous the formation may

seem, rock movement discloses zones of inherent weakness along which the movement is largely concentrated.

Causes of Movement.—Rock failure is evidence of overpowering stresses, but the causes and directions of these stresses are not so clear. Failure on a mountainous or continental scale points to great earth stresses of the kinds which have been variously ascribed to adjustments under gravity between earth masses of differing densities and topographic relief, to adjustments under gravity of a solid shell to a shrinking centrosphere, a conception based on the supposed transfer of heat and magmas from the centrosphere outward, to tidal strains, to changing centrifugal pressures caused by changes in rate of the earth's rotation, or to combinations of these causes.

So clear is the evidence that great earth forces of this kind have been operative that other causes of movement have been perhaps underestimated or ignored in explaining local failure. Such are the pressures and changes of temperature attending the extrusion and intrusion of igneous rocks, in the vicinity of which there is often clear evidence of local failure, the recrystallization of rocks during long periods causing local changes of volume, the leaching of substances near the surface causing voids and weakness and consequent slump under gravity, and other volume changes under weathering. When rocks are in a soft and incoherent condition, they are especially susceptible to local stresses. Mud, marl, sand and salt deposits crumple and slip as the deposits are slowly built up, either under air or water. Local loading by water and ice or rock materials may cause them to fail. Unconsolidated glacial deposits show a variety of joints, faults, and folds. In the settling, consolidation, and desiccation of soft deposits, stresses are set up resulting in local failure. When the deposits are seen later as hard rocks it is difficult to determine the extent to which the failures are to be attributed to these early and local causes acting during the soft formative stages, and to what extent they are the result of regional deformation after the rocks are strong and hard.

The part played by the forces of crystallization in initiating earth stresses is yet but little understood. Growing crystals have been found experimentally to exert considerable linear forces. There seems to be evidence in rocks that these forces have been sufficient to widen openings or to expand the rock mass. Crystallization may also contract the rock mass. The impressive manner in which crystal habit asserts and maintains itself under most intense conditions of metamorphism seems to indicate the reaction of considerable forces of crystallization to external environment. It is the custom usually to explain such facts on the basis of adaptation to environment, and to put the emphasis largely on the environmental conditions as determining the outcome. It is clear, however, that these conditions have not been sufficiently intense to interfere with or overcome the tendency of crystals to take whatever form best suits their atomic structure—in other words, to develop their own habit. The philosophy of the precise relations between inherent crystallizing power and environmental forces is not understood, but enough is known to warrant the suspicion that the cumulative effects of the forces of crystallization may themselves initiate earth stresses of a high order of magnitude.

In my own structural field work, I have become impressed with the necessity for better criteria for the separation of rock structures due to local causes of the kind above indicated from the results of failure under the greater regional earth stresses. Of course there is no clean-cut separation between the two. An accumulation of minor and local causes may cause relatively large earth movements, and conversely major earth movements are resolved into a complex of minor related structural phenomena.

Angular Relations of Rock Structures to Causal Stresses.—Just as structures in themselves do not indicate all the causes of failure, neither do they indicate clearly the directions of application of stress. On the whole the geologist's attempt to relate specific structures with specific stress systems has not been

highly successful. The various structures resulting from rock failure have usually been explained on the simple conception of the application of a non-rotational stress—either tension, causing elongation in the direction of pull, or simple compression, producing a shortening parallel to the principal stress and elongation at right angles to it. A fold, for instance, is assumed to indicate application of stress normal to its axial plane; a set of compressive joints is taken to indicate application of stress at 45° to the fractures; cleavage is taken to indicate application of pressure normal to its plane. Experimental work on rock deformation has been conducted mainly with the same limited assumptions, and the results have been widely quoted and applied to the interpretation of rock structures in the field. These conceptions may be correct as far as the immediate feature is concerned, but the forces are only minor constituents of the major causal movement and give no clue to its direction.

Much less attention has been paid to the conception that the compressional forces may be rotational, that is, that they may be applied in the form of a couple. Under this conception, the net result is a shearing between the heterogeneous rock units along planes ranging from parallel to 45° to the principal axis of stress, the shearing usually accompanied by local tension—in other words, no matter what the origin of compressional stresses and their angle of application, when applied to the heterogeneous rock masses constituting the earth they tend as a whole to act in couples and are resolved into components usually acting in directions inclined to the resulting planes of movement. A mountain making movement under this conception is a shear of certain rock masses over others, resulting in faults, joints, folds, and cleavage. Tensional stresses may be minor consequences of such shear. Field observations within the range of my own experience favor this view of the dominance of shear. It is the view also which geologists have commonly applied to an assumed shear of a thin brittle crust over a thin mobile zone below, though curiously enough not to the local structures that can be observed.

Illustration of Shear Structures.—To illustrate the prevalence of shear structures: Most folds are not symmetrical and indicate by the inclination of their axial planes a drag of one structural unit past another. When this relation is conspicuous they may be called "drag folds." A fold has usually been regarded as indicating direct shortening normal to its axial plane, and therefore application of stress normal to this plane. The Appalachian folds, for instance, have been ordinarily discussed as indicating pressure from the northwest and southeast. The same results, however, can equally well be produced by a differential or shearing movement acting in directions inclined to the trend of the fold axes or to the mountain range as a whole. Experimental reproduction of Appalachian folds under shearing stresses gives more satisfactory results than experiments with normal shortening.[2] The folds indicate the direction of the shortening or elongation, in other words of the nature of the strain, but not the angle of application of the stress.

The interpretation of rock cleavage or schistosity, a common though not the only evidence of rock flowage, affords an especially good illustration of the danger of using narrow assumptions as to its relations to causal stresses. Cleavage is a capacity to part along parallel surfaces determined by the parallel dimensional arrangement of mineral particles. There is abundant proof that the schistose rock has been elongated parallel to the cleavage surface, and cleavage thus becomes evidence of elongation. It does not follow, however, that the stress producing elongation was applied normal to it.

The elongation may well have occurred under a shearing stress of the sort which exists when a mass of dough is rolled out on the table by the application of stress inclined to the table surface. Field studies of cleavage seem to indicate that in the majority of cases

2 Mead, W. J., "Notes on the Mechanics of Geologic Structures," *Jour. Geol.*, Vol. 28, 1920, pp. 521–523.

the cleavage is merely the expression of the yielding of a weaker formation or weaker part of a formation by a slipping or differential movement between harder members. Even in areas with regional cleavage, the same interpretation may be applied on a large scale when the harder units in adjacent terranes are taken into account. My own observations in old pre-Cambrian terranes tend to the conclusion that cleavage, indicating rock flowage, has been confined to comparatively narrow mesh-like zones between large massifs. The evidence leading to this conclusion that cleavage is the result of slipping between rock masses may usually be checked by drag folds which develop simultaneously in the softer rocks, and by fissures and faults which develop simultaneously in the harder rocks.

The zones of movement marked by cleavage may have almost any inclination or direction, but the plane of the cleavage itself has a strong tendency toward steep inclination or verticality. Both in strike and dip the cleavage is more uniform than the movement zone of which it is a part. The relation is not unlike that between folds and cleavage, to be presently discussed. This steep inclination of cleavage does not necessarily indicate prevailing horizontality of stresses on the assumption that cleavage must develop normal to stress. In part it may have this relationship, but when considered in relation to folds and relative movement of adjacent massifs it more often indicates shearing stresses inclined to the cleavage. So far as any general inference is possible, the tendency of cleavage to show uniform strike and steep inclination over great areas suggests differential movement in vertical or steeply inclined planes, the movements *in* these planes ranging from vertical to horizontal. It can not be explained by movement along planes tangential to the earth, which would require prevalence of flat or gently inclined cleavage. In short the attitude of cleavage, so far as it may be generalized, does not correspond to the conception of the tangential shearing of a competent surface zone over a mobile zone below.

Cleavage has a definite relationship to folds which is of great usefulness in interpretation of rock structures, and which affords valuable suggestions as to the general relations of cleavage to the great zones of flowage of which it is often an expression. Cleavage is approximately parallel to the axial planes of the folds. It therefore usually stands more steeply than bedding and is more uniform in dip and strike than bedding. Where cleavage is noted in a rock outcrop, the direction and inclination of the axial planes of the folds are thereby indicated—not only for the folds within the rock observed, but also, usually, for the folds in the adjacent rocks as well.

As a consequence of the fact that cleavage is roughly parallel to the axial planes of folds, it follows that the trace of any bedding plane on the cleavage surface indicates approximately the direction and degree of pitch of the fold, that is, the inclination of the axial line of the fold to the horizontal. A single fragment of cleavable rock appearing in an outcrop may be sufficient to establish the pitch for a considerable area.

The inclination of bedding to cleavage—always remembering that the latter indicates the attitude of the axial plane of the fold—indicates faithfully the position of the observed bedding on the fold, whether the fold be upright inclined or overturned. This principle is useful in determining whether a bed is right side up or overturned. Inferences of the same sort may be drawn from strike observations on bedding and cleavage in deformed areas.

Still further, cleavage is a phenomenon of rock flowage. The very existence of cleavage, therefore, means the rock has been deformed under the conditions of rock flowage, where the folds are likely to be of a rather intricate type, with much interior thinning and thickening of the beds. Even though evidences of this folding are not immediately at hand, the very existence of cleavage on a considerable scale indicates with reasonable certainty the existence not only of folds, but folds of the rock flowage type.

All of these inferences may be made induc-

tively from a surprisingly narrow range of observation.

These remarks on cleavage apply to the structure ordinarily associated with the deformation of rocks which is almost without exception inclined to bedding or other primary structures. They do not apply to cleavage developed solely by load or gravity, which might reasonably be expected to be horizontal. The latter type of cleavage has been described for certain terranes and districts, as for instance in the Belt series of the Canadian boundary; but within my own observation of deformed areas it is a phenomenon of such local and special character as not to invalidate the generalizations above made. So far as load cleavage is assumed to develop under static conditions of load, without movement, I doubt its existence. Cleavage usually indicates movement, not static pressures.

The interpretation of jointing and faulting has likewise suffered from far too narrow and simple assumptions of the mechanical conditions. Quoting from a recent paper by Mead,[3] such a simple structure as an open fissure or joint "obviously due to tensional stresses (so far as the fissure itself is concerned) may be an incident in simple elongation, shear, cross-bending, compression or shortening, or torsional warping. A reverse fault implies conditions of shortening or compression but may in addition to this possibly be an incident in a general shearing movement, or a phenomenon of simple cross bending, or may be due to torsional warping." In my own field of experience I have been impressed with the frequency of joints and faults developed as incidents in differential or shearing movements. There is rapidly accumulating evidence of the existence of great thrust faults with low dips as prominent features of diastrophism.

When the shearing movements have been determined by the study of a single type of structure like folds, important corroborative evidence may be obtained from other structures. Instead of regarding structures as independent units, each with its own set of mechanical conditions, they may be viewed as a group expression of some major movement. When so viewed the shearing nature of the movement often becomes obvious.

Distribution of Movements.—Within our zone of observation, it is difficult to say inductively whether or not there has been more movement or less movement with depth. Neither is it possible with any satisfactory degree of definiteness to discern controlling attitude or pattern in the complex of movement zones. The zones range from vertical to horizontal, are parallel or intersect. The original horizontal position of stratified rocks naturally suggests dominance of the horizontal element in movements affecting them, because of resolution of forces along bedding planes of weakness, but the beds soon become inclined or vertical when deformed and disturbed zones may be anything but horizontal. The less deformed masses between may have almost any shape. Locally they may be discoidal, or sheet-like, or oval or rod-shaped, or rhomboidal. Interesting attempts have been made to discern some controlling pattern, both in large and in small structural features, but subjective hypotheses enter to so large an extent that the reality of the pattern presented is often not convincing to others.

Possible Increase of Rock Flowage with Depth.—Within a few hundred or at most a few thousand feet of the surface, fracturing, much of it open, is clearly the dominant process, though even here soft rocks may yield by flowage. In the lower part of the zone of observation combined fracture and flowage is the rule. Fractures are more commonly of the closed shearing type. It has been easy to assume that this combination is merely transitional to a zone of flowage below. The fact that rocks which have been deeply buried are often highly schistose as a result of rock flowage has been cited as indicating increased rock flowage with depth. I have shared in this view. From some familiarity with ancient and formerly deeply buried terranes, I am not sure, however, but that a careful inductive study of field sections requires considerable qualifications of this generalization. Many instances may be cited of rock flowage occurring high

[3] *Loc. cit.*, pp. 505–506.

in the geologic section and rock fracture below. On the whole, the oldest rocks undoubtedly show greater evidences of rock flowage, though even here such evidences are localized in relatively narrow and numerous zones. These rocks have suffered more periods of deformation, some near the surface and some deep below, than the younger rocks. The present evidences of flow do not necessarily indicate that all the flowage occurred at great depths. Plutonic intrusions of great mass often, not always, cause rock flowage in the adjacent beds, and so far as such intrusions are more numerous with depth, rock flowage may increase. On the other hand, some plutonic intrusions in younger series which have not been very deeply buried likewise cause rock flowage. Certain it is that shearing movements, resulting in displacements which we call faults, have extended down to the bottom of our zone of observation. These partake of the nature of rock fracture in their confinement to planes and in their relations to stresses, but whether the processes be called flow or fracture is partly a matter of definition to which we shall presently make further allusion.

II. THE UNSEEN ZONE BELOW

Below the zone where the evidences of structural failure can be observed, conceptions of the structural behavior of rocks are based on such a variety of assumptions that the layman, and for that matter the geologist, has much difficulty in understanding and reconciling the various views. It is certain that rocks fail in this zone; there is evidence which permits of no other conclusion; but the manner, distribution, and causes of this failure are by no means clear. There are certain fundamental facts upon which any hypothesis must be built.

Known Facts.—Tidal experiments have shown that the earth as a whole is stronger than steel and acts almost as an ideally rigid substance.

The behavior of earthquake waves indicates that the earth behaves as a solid throughout; and for the outer quarter of the earth, at least, the waves increase in velocity of transmission with depth, showing that elasticity and rigidity increase faster than density.

Under surface conditions a dome of the strongest rock, corresponding to the sphericity of the earth, has a calculated supporting strength equal only to a very small fraction of the dome's own weight; but experimental work on deformation of rocks has shown that, with increase of containing pressures or cubical compression, the rock takes on a rigidity capable of resisting enormous stress differences. The range of experimental evidence is not yet sufficient to show the magnitude of these differential stresses necessary to produce deformation under the conditions of pressure which might be reasonably inferred below our zone of observation; but quoting from Adams[4] "the experiments seem to indicate that with a containing pressure of about 10,000 atmospheres, which would be equivalent to a depth of about twenty-two miles below the surface, it would be impossible to make the marble flow, except under a pressure which would be simply colossal." Geologic evidence seems to indicate a supporting strength in the deep zone far greater than that of surface rocks.

The rocks in the deep zone are under higher temperature and greater pressure than in the zone of observation. Some notion of the quantitative values of these factors is afforded by downward extrapolation of observed gradients nearer the surface.

The density of rocks within the zone of observation averages about 2.7; the density of the earth as a whole as determined astronomically is in round number 5. It follows, therefore, that the density of part of the earth must be higher than 5, and that the density of the deep zone must be higher than at the surface; but beyond this the distribution of density in the deep zone, both vertically and horizontally, are unknown.

By means of the plumb line and pendulum,

[4] Adams, Frank D. and Bancroft, J. Austen, "On the Amount of Internal Friction Developed in Rocks during Deformation and on the Relative Plasticity of Different Types of Rocks," *Jour. Geol.*, Vol. 25, 1917, p. 635.

it is known that the horizontal distribution of densities is heterogeneous. The density is low in the earth protuberances and high in earth depressions, as if the earth masses were in flotational equilibrium. The subcrustal densities are balanced against topographic relief. This is called isostatic equilibrium. Certain parts of the earth, called negative elements by Willis,[5] seem to have been subjected during geologic history to long-continued deposition. Other parts, called positive elements, have been more commonly subjected to erosion than deposition. Negative elements are heavy and positive elements are light. Loading and unloading is not necessarily the primary cause of movement, but may serve to accentuate an inherent and prevailing tendency to isostatic adjustment between masses of differing density.

Isostatic balance is not complete. Some parts of the earth vary from this condition, suggesting that they have sufficient strength to sustain themselves in opposition to isostatic tendencies.

The observed relations between density and relief may be explained on the assumption that the differences in density extend uniformly to a depth of about 75 miles, called the depth of isostatic compensation. This figure is favored by geodesists. No one knows, however, the density gradients deep below the surface, or the extent to which there is heterogeneous vertical distribution of density. If instead of assuming the uniform downward extension of densities observed at the surface, assumptions are made of other vertical distributions of density, various other depths of compensation may be calculated, ranging up to several hundred miles. So far as geologic evidence goes, it seems to favor the view that depth of compensation is not uniform.

A comparison of the up-lift of mountain masses with their horizontal shortening indicates how deep the mountain making movements have extended.[6] In general sharp close folding indicates a comparatively shallow depth, whereas broad open folds, approaching the plateau type of deformation, can be explained only by movements of material extending to great depths. Major features of continental and oceanic relief also seem to require the latter inference. If the amount of shortening observed in some mountain ranges were to extend downward indefinitely, mountains much higher than those actually formed would have resulted; hence the conception of considerable movements of a shallow shell without equivalent movement below, and thus perhaps the conception of mobility of an intervening layer, though at widely different depths in different localities.

Geologic evidence points to periodicity in earth movements, indicating that the adjustment to stress is not uniform and continuous.

Finally, magmas originate well below our zone of observation and presumably take part in the mechanical easements. From the known conditions of rigidity already indicated, it seems certain that liquid condition is local and intermittent. Quoting from Gilbert:[7]

> The continuous or secular relations of pressure, temperature, and density in the subterranean region from which liquid rock rises at intervals may be assumed to be such that moderate change of condition either induces liquefaction or else so lowers the density of rock already liquid as to render it eruptible; and such a balancing of conditions implies some sort of mobility.

From these facts it is clear that earth movements extend to considerable depths below our zone of observation, that the movements are periodic, that the earth as a whole is more rigid than steel when subjected to sudden stresses like earthquake shocks or tidal pulls, that it yields slowly and periodically to long continued stress; that as a whole it is sufficiently weak to allow a large measure of isostatic adjustment, but still strong enough to

[5] Willis, Bailey, "Discoidal Structure of the Lithosphere," *Bull. Geol. Soc. of Am.*, Vol. 31, 1920, p. 277.

[6] Chamberlin, R. T., "The Appalachian Folds of Central Pennsylvania," *Jour. Geol.*, Vol. 18, 1910, pp. 228–251; "The Building of the Colorado Rockies," *Jour. Geol.*, Vol. 27, 1919, pp. 145–164, 225–251.

[7] Gilbert, G. K., "Interpretation of Anomalies of Gravity," Prof. Paper 85, U. S. Geol. Survey, 1914, p. 34.

support considerable structures against isostatic tendencies; that it is not essentially molten or fluidal in the ordinary sense; that molten magmas are probably local and incidental.

As to depth and distribution of the movements, and as to the manner of movement, whether by fracture or plastic flow or by some unknown process, there is wide divergence of opinion. Likewise, there is doubt as to the laws or control under which stresses may be transmitted. We may refer briefly to these questions.

Does a Zone of Weakness or Mobility Exist in the Unseen Depth?—A common conception of the distribution of movement deep below our zone of observation confines it to a single spherical zone of weakness or mobility surrounding the centrosphere and surrounded in turn by a rigid shell. This zone is supposed to be marked by a capacity to yield readily to long enduring strains. It may be in part the generating zone of magmas, which may be a factor in its supposed easy yielding. The conception of the existence of a weak and mobile zone has found expression in several ways.

The widely held belief in the existence of a zone of rock flowage below a surficial zone of fracture has commonly carried with it an assumption of the relative weakness and mobility of this zone. In fact "zone of rock flowage" and "zone of weakness" have come to be almost synonymous in discussion of this problem. Doubt as to this correlation is expressed later. Even if the existence of a single zone of rock flowage were proved, it does not necessarily follow that this is a zone of weakness.

Van Hise assigned a depth of only six miles to the top of this zone, though with the important reservation that increased rigidity under containing pressures would greatly increase this figure.

Adams and Bancroft,[8] on the basis of experiments with rock failure under great containing pressures, conclude that the amount of tangential thrust required to produce movements increases so rapidly below the surface "that the great movements of adjustment by rock flow or transference of material in the earth's crust from one point to another—other than the transference of rock in a molten condition—must take place comparatively near the surface," and that the ease of movement "increases rapidly in proportion to their nearness to the surface." The mobile zone thus implied is inferred from experimental results to be limited to depths within 35 miles, below which a condition of no mobility seems to be assumed.

Gilbert conceived "a relatively mobile layer separating a less mobile layer above from a nearly immobile nucleus," the mobile layer agreeing in depth with the depth of isostatic compensation.

Barrell called this weak zone the asthenosphere and assigned its provisional boundaries at depths of 75 and 800 miles from the surface. This he conceived to underlie the zone of isostatic compensation, which was calculated by Hayford to be 75 miles below the surface.

Hayford assumed concentration of movement within the lower part of the zone of isostatic compensation, that is within 75 miles of the surface.

Willis concludes that there is a zone of adjustment below 40 miles and extending to the base of the asthenosphere, and that the adjustments necessary to isostatic undertow take place mainly between 45 and 100 miles from the surface.

In contrast to these conceptions of a deep mobile zone, are the views of T. C. Chamberlin and R. T. Chamberlin, who postulate multiplicity and irregularity of movement zones.

R. T. Chamberlin[9] concludes that mountain making diastrophism affects wedge shaped masses and implies steeply inclined zones of movement.

T. C. Chamberlin emphasizes the superficial nature of diastrophic movements of the mountain making kind, whether these are tangentially compressive or the result of creep of continental masses under gravity. In regard to deeper, so-called massive, movements of the

8 *Loc. cit.*, p. 635.

9 *Loc. cit.*

kind reflected in major features of continental and oceanic relief, he does not assume any mobile substratum, but rather steeply inclined zones of movement. As he states it:[10] "Inherited inequalities of specific gravity are, perhaps more than any other agency, the governing power in shaping if not actuating diastrophic movements"—but that "the normal mode of isostatic adjustment in such an earth is thought to be wedging action in the form of movements on the part of its constituent tapering prisms, conical, pyramidal, or otherwise, in response to the varying stresses imposed on them. . . . They should reach to whatever depths may be seriously affected by differential stresses of an order requiring readjustment. No undertow in a hypothetical mobile substratum is necessarily involved and none is postulated."

These are only a few of the views that might be cited to indicate the wide range of hypotheses possible as to depth, number, and attitude of deep mobile zones. The very diversity of these views emphasizes the restricted range of known facts. The requirement of proof naturally rests most heavily on hypotheses which most precisely restrict the locus of movement. So many assumptions must enter into this proof that in our present state of knowledge it can not be rigorous. The safest scientific attitude for the time being would seem to be one of rigid adherence to the known facts, and the recognition of the possibility of more than one hypothesis to explain them. This is not incompatible with a sympathetic attitude toward the efforts of those attempting proof of a single hypothesis.

Until the time comes when it is possible to furnish definite proof of any specific localization of movement, my own inclination is to keep clearly in mind the distribution of movements within the zone of observation, already summarized, as perhaps the best guide to the condition that may be assumed at least for some distance below our lowest observations. This measuring stick is short, but there are some reasons for believing that it is as good as any yet available to measure our course through the complex of hypotheses possible in the deep zone. Especially is it desirable to keep in mind the fact that cleavage, indicating rock flowage, as observed in the deepest part of our zone of observation, does not in general have an attitude required by the conception of tangential shearing in a mobile zone. This does not disprove a different attitude below, but it does eliminate an affirmative bearing on the question which has been sometimes implied.

[10] Chamberlin, T. C., "Diastrophism and the Formative Processes," *Jour. Geol.*, Vol. 21, 1913, p. 520; Vol. 26, 1918, p. 197.

Are Deep Movements Accomplished by Rock Flowage Rather than by Rock Fracture?—It remains to consider the manner or processes through which deep movements are accomplished, whether by plastic flow, by fracture or by some combination of these kinds of deformation. The widely current hypothesis is that deformation in the deep zone is mainly by rock flowage. The deformed rocks have not been seen, nor have the environmental conditions been accurately measured; yet there are weighty considerations favoring this view:

Experimental work has shown that rock flowage requires containing pressures equal at least to the crushing strength of rocks, and these pressures surely exist in the deep zone. Within the zone of observation even the strongest rocks have locally suffered rock flowage and hence have locally, even at that shallow depth, been under containing pressures sufficiently in excess of their crushing strength to permit flowage. With greatly increased pressures at greater depths it is logical to argue that conditions for flowage would be improved. Under these conditions the resistance to deformation is a function of the internal friction or viscosity of the rock. This property does not of necessity bear any relation to the compressive strength or competency of the rock—qualities which determine its behavior in the absence of great containing pressures. Quartzite or granite, so far as we know, may have no greater viscosity than marble or slate. Adams' experiments show diabase and marble in a composite

specimen behaving similarly. In fact marble actually penetrated the harder diabase. Likewise, gypsum penetrated steel. While there are probably differences in the internal friction or viscosity of different rocks under these conditions, the results are nevertheless homogeneous in approximating rock flowage—in contrast to the heterogeneous results under less containing pressures where competency and strength of rocks play a part.

Earth temperatures increase with depth. Increase in temperature aids and accelerates rock flowage. This is evidenced by flowage of hard rocks at moderate depths at batholithic contacts. Also facts of physical chemistry show that increase of temperature increases molecular activity, hastens endothermic reactions (anamorphic reactions are largely endothermic), increases solution, both liquid and solid, and hence recrystallization, and decreases viscosity or internal friction.

Notwithstanding these and other considerations, any conclusions as to the existence of a deep zone in which all rocks flow when deformed is hypothesis, not proved fact, and perhaps will always remain so. The environmental conditions are not accurately known; and even if each of the factors were measured, their conjoint effect is still speculative. Variations in the time factor alone may determine whether a rock flows or fractures. Rock flowage which has occurred in rocks now accessible to our observation fails to indicate increase with depth with sufficient clearness and definiteness to warrant confident downward projection.

Experimental evidence has been construed to indicate that under great containing pressures, of the kind probably existing at depth, the movement under thrust or shear is of the nature of rock flowage, but this is partly a matter of definition. The rock breaks and granulates, often along definite planes, but the parts are still held together; it really flows. Displacements along these planes may partake of the nature of faults, and there is no development of true flow cleavage determined by a parallel arrangement of minerals under recrystallization, the common geologic evidence of rock flow. Presumably with longer time and proper conditions of temperature and mineralizers, parallelism of newly developed minerals, characteristic of rock flow, would result. So far as the experimental results go, however, they fail to exhibit structures which in ordinary geologic field interpretation would be classed as *typical* rock flowage. They would be called fracture or combined fracture and flowage. They would be described as shear planes and faults. They might suggest rupture of the kind that originates earthquake shocks.

Rock flowage has been widely assumed to indicate weakness and mobility. The correlation of rock flowage with weakness may arise from the fact that certain soft rocks such as shales, which are inherently weak, may often be observed to have undergone rock flowage, while adjacent strong rocks have been unaffected. Or, a zone of flowage passing through a homogeneous formation unquestionably indicates movement along the flowage zone, and, therefore, indicates the weakness of this zone relative to adjacent undeformed parts of the mass. But it would be equally valid to argue that where fracturing has been concentrated along a zone between undeformed rocks it too indicates movement, and therefore relative weakness. It is a long step from this to the conclusion that flowage indicates greater weakness than fracture. It is entirely conceivable that it might require more energy to make rock flow than to make it fracture. Indeed there is some reason for believing, both from experimental work and from observations in areas of combined fracture and flowage, that relief actually takes place first and most easily by fracture and that flowage occurs only when it is possible to concentrate much more energy into the rock. Both structures show weakness relative to adjacent undeformed masses, but in relation to each other degree of weakness is a much more complicated problem.

Our question, then, as to the extent to which deep movements are accomplished by rock flowage can not be simply and definitely answered in the present state of knowledge.

The preponderance of environmental evidence seems to indicate that rock flowage is the distinctive kind of movement, but so many qualifications, definitions and assumptions enter into this conclusion that my present inclination is to keep firmly in mind the complex facts of deformation in our zone of observation as a possible key to the interpretation of unseen movements. This attitude will require us to pay more attention than heretofore to the possibilities of heterogeneous structural behavior at great depths. Particularly should we keep in mind the fact that the kind of rock flowage accomplished experimentally produces structures which in the earth have sometimes been called fracture or combined fracture and flowage. We may assume a downward extension of combined fracture and flowage, as observed in the field, and still meet the conditions of flow implied by experiment.

How Are Stresses Transmitted in the Deep Zone?—In our zone of observation stresses are clearly transmitted by the competent members of the lithosphere. In any area of deformation evidence may usually be found of the control of the structure by one or more competent members. When the notion was widely held that the interior of the earth was molten or fluidal, hydrostatic stress conditions were naturally assumed. With the later knowledge that the earth acts essentially as a solid throughout, this view was largely abandoned in favor of the view that rocks in the deep zone act as rigid competent members capable of transmitting stresses in definite directions. The vector properties of cleavage and other structures supposed to develop in this zone were cited to indicate the definite orientation of stresses. It does not follow from this, however, that pressure conditions were or are not hydrostatic, especially under slow movements. Rocks under compression from all sides greater than their crushing strength seem to transmit stresses in a manner suggesting approach to hydrostatic conditions of pressure. When the stress differences are such as to require it, there is movement in the direction of easiest relief. The stress as reflected by the movement would seem to have been transmitted in a definite direction, and yet the pressures may have remained hydrostatic. If we were to imagine a volume of liquid deep below the surface subjected to differential stress sufficient to deform its containing walls, it is clear that the movement would be in the direction of easiest relief, notwithstanding the hydrostatic conditions within the liquid. Periodicity of movement is possible under this conception. Rock structures indicate movement only, not necessarily the inherent stresses. Movement of rocks under the conditions supposed to obtain deep below the surface seems likely to be at least in part a matter of relief of materials so contained between rigid members that the direction of escape is definitely oriented. Of course this supposition assumes that on some scale, small or large, there are units of mass competent to act as retaining walls for materials acting under hydrostatic pressure. If all the mass in the deep zone were under hydrostatic pressure, the retaining walls might be regarded as the solid shell above, inequalities in the competence of which would control the movements in the direction of easiest relief. However, rock structures, such as cleavage and folds, with vector arrangement of the sort observed near the surface and of the sort supposed to exist below, tell us only of the direction of movement and fail to indicate whether the stresses are hydrostatic or otherwise.

CONCLUSION

Within the zone accessible to observation movements of rock masses are accomplished by fracture and flowage. These processes may be distinct and separate, or so interrelated as to make definition difficult. The zones of movement are many, their positions and attitudes diverse. In general they indicate shearing or grinding movements between rock masses, accomplished both by fracture and flowage, and caused by stresses inclined to

the zones of movement. This conception is taken to afford the best initial basis for the interpretation and correlation of observed rock structures. There is no certain evidence of increase or decrease of movement toward the bottom of this zone. Beyond a shallow surface zone, there is no certain evidence of increase of rock flowage and decrease of rock fracture with depth. There is no certain evidence that rock flowage means greater weakness than rock fracture. There is no certain evidence in rock flowage that pressures are dominantly hydrostatic or dominantly those of competent solid bodies.

Movements are known to occur in the zone below our range of observation, but their nature and distribution are the subjects of varied hypotheses based on a few known conditions. Much of the sharper diastrophism seems to be confined to a thin surficial zone. Deeper movements, of a more massive type, periodic, and possibly slower, seem to be implied by the relative movement of great earth segments as represented by continents and ocean basins. Their depth is unknown. Most of the current hypotheses agree in assuming a single mobile zone in which rocks move dominantly by rock flowage. The basic requirements of reasonable hypothesis, however, may be equally well met by a conception of movement much like that of the zone of observation. This does not require or postulate the conception of the existence of any single mobile zone, or zone of slipping, or zone of flowage, or of an asthenosphere. It supposes movement irregularly distributed in many zones, with any inclination, and accomplished by both fracture and flowage as far below the surface as movement extends—always remembering that some of the structures geologically described as fractures, may be expressions of mass movement of the kind defined as flow in experimental results.

Conditions of temperature and pressure and vulcanism become more intense with depth, but it remains to be shown that their conjoint action results in a uniform environment, and even if it does, that this condition is not upset by what might be called a heterogeneity of the time factor as represented by differing rates of deformation. If homogeneous environmental and time conditions are assumed, it is yet to be shown that these are sufficient to overcome the heterogeneity of the physical properties of the rocks and to cause homogeneous behavior through any considerable zone. It is not even certain that they may not fix and accentuate the heterogeneous properties of rocks. Certainly in the zone of observation there is comparatively slight evidence of their efficacy in causing more uniform deformation with depth.

In short, as between alternative conceptions as to the conditions in the deep zone, the burden of producing affirmative evidence would seem to rest heavily on any conception involving radical departure from the known irregular distribution and manner of movement within our zone of observation. We come, therefore, to the Chamberlin conception of a heterogeneous structural behavior of the earth.

C. K. Leith

University of Wisconsin

SCIENTIFIC EVENTS

DINNER IN HONOR OF THE RETIRING SECRETARY OF AGRICULTURE

The success of Secretary E. T. Meredith in interesting the public in the investigational work of the U. S. Department of Agriculture has been unique. His prompt recognition of the needs of the department and his activity in behalf of the investigators there, have attracted the attention of scientific men throughout the country. Coming to the secretaryship at a time when the morale of the scientists in many government departments was being seriously impaired through discouragement as to the possibility of securing adequate support for investigation, his campaign of education had the effect both of awakening the public to the extent and importance of the work, and of heartening the workers.

It was then appropriate that before his retirement, there should be some demonstration of appreciation by the scientists themselves. This took the form of a buffet supper at the Raleigh Hotel, Washington, February 16. The event was planned by a committee chosen from the membership of the various Washington scientific societies in which the Department of Agriculture is largely represented. In the menu were included various items representative of the work of the department, such as "Dasheen Chips," "Soy Bean Sauce," "American Roquefort Cheese," and "New Unnamed Grapes." During the evening, Dr. B. T. Galloway presented Secretary Meredith with a vellum volume bound in hand-tooled, dark morocco, and containing the following inscription of appreciation signed by the five hundred and sixty scientific and technical men who attended:

> The researches of the United States Department of Agriculture in recent years have become so diversified and so important for the welfare of the country and are so absolutely dependent on a wise, far-seeing and sympathetic administration, such as you have given us, that your departure from among us is a matter of very general regret.
>
> Your broad comprehension and appreciation of the fundamental importance of scientific research in agriculture, your prompt recognition of the needs of the service and your enthusiasm and effective efforts to secure proper recognition of the work and workers have been most stimulating to us and have been of the greatest value in promoting a better understanding of the activities and purposes of the department and their vital relation to the business and industrial interests of the nation and the progress of the whole people.
>
> In view of the above facts, we the undersigned, desire to express our deep appreciation and to thank you for what you have done and extend to you our hearty good wishes for all time to come.

In response, the secretary spoke briefly of his interest in the scientific work of the department, and his hopes for its future development. The esteem in which Mr. Meredith is held, was evidenced by the large attendance at this unofficial gathering. And the spirit of those present was such that when all joined in a rousing cheer for "Meredith" and in singing "He's a jolly good fellow" it seemed not only wholly in harmony with the occasion, but a fitting expression of their enthusiasm for the man.

CONGRESS ON MEDICAL EDUCATION

The Annual Congress on Medical Education, Licensure, Hospitals and Public Health will be held at Chicago on March 7, 8, 9 and 10, under the auspices of The Council on Medical Education and Hospitals, and The Council on Health and Public Instruction of the American Medical Association, The Association of American Medical Colleges, The Federation of State Medical Boards of the United States and The American Conference on Hospital Service.

The program of the sessions on Medical Education are as follows:

Introductory Remarks, Arthur Dean Bevan, chairman of the Council on Medical Education and Hospitals, Chicago.

The Significance of Group Practise in its Relation to the Profession and the Community, Veader N. Leonard, Academy of Clinical Medicine, Duluth.

SYMPOSIUM ON GRADUATE TRAINING IN THE VARIOUS MEDICAL SPECIALTIES

Medicine and the Medical Specialties—

- (*a*) Internal medicine, George Blumer, clinical professor of medicine, Yale University.
- (*b*) Pediatrics, Harry M. McClanahan, professor of pediatrics, University of Nebraska.
- (*c*) Nervous and mental diseases, Arthur S. Hamilton, professor of nervous and mental diseases, University of Minnesota.
- (*d*) Dermatology and syphilology, William A. Pusey, emeritus professor of dermatology, University of Illinois.

Surgery and the Surgical Specialties—

- (*a*) Surgery, Charles H. Frazier, professor of clinical surgery, University of Pennsylvania.
- (*b*) Ophthalmology, Walter B. Lancaster, Boston.
- (*c*) Oto-Laryngology, Wendell C. Phillips, New York.
- (*d*) Orthopedic surgery, Robert W. Lovett, professor of orthopedic surgery, Harvard University.

(c) Urology, Hugh H. Young, clinical professor of urology, Johns Hopkins University.

The Relation of the General Practitioner to the Specialist, James B. Herrick, professor of medicine, Rush Medical College.

Obstetrics and Gynecology, J. Whitridge Williams, dean and professor of obstetrics, Johns Hopkins University.

Public Health and Hygiene, Victor C. Vaughan, dean and professor of hygiene and physiological chemistry, University of Michigan.

Preclinical Subjects—

(a) Anatomy, Albert C. Eycleshymer, dean and professor of anatomy, University of Illinois.

(b) Physiology, Joseph Erlanger, professor of physiology, Washington University.

(c) Pharmacology and therapeutics, Charles W. Edmunds, professor of materia medica and therapeutics, University of Michigan.

(d) Pathology and bacteriology, James Ewing, professor of pathology, Cornell University.

Summary of Reports on Graduate Training in the Specialties, Louis B. Wilson, chairman of the Council's Committee on Graduate Medical Education, Rochester, Minn.

THE MANUFACTURE OF CHEMICALS FOR RESEARCH WORK

To reduce the cost of chemicals needed for research work in various scientific departments of the University of Wisconsin, the chemistry department will give a new course in the manufacture of organic chemicals during the summer session under the direction of Professor Glenn S. Skinner. The only other course of this kind given anywhere in the country is at the University of Illinois.

Professor J. H. Mathews states that most of the chemicals now available for experimental work are obtained only at excessively high prices and the department is compelled to make the choice between excessively high laboratory fees or curtailment of laboratory instruction. It will be possible with the laboratory facilities available during the summer months to manufacture these chemicals more cheaply than they can be purchased, thus materially cheapening the cost to the student.

All men of science in the university have been asked to leave their orders for chemicals with Professor Skinner and as far as is possible these orders will be filled by his course.

Only eight advanced students will be admitted to the course, and they will work from nine to ten hours a day and will receive about 40 cents an hour for their work. Only the most promising graduates and upper classmen will be selected for the work, with the view to giving them intensive training in practical organic chemistry and experience in larger scale operations.

INSTITUTE FOR FOOD RESEARCH AT STANFORD UNIVERSITY

The Carnegie Corporation of New York announces that it has entered into an agreement with Leland Stanford Jr. University, by which a food research institute is to be established at the university for the intensive study of the problems of production, distribution and consumption of food. The corporation expressed hope that the new organization will in time be known as the Hoover Institute.

Need for such an institution was first suggested to the corporation by Mr. Herbert Hoover, former food administrator and a trustee of Stanford University. The selection of Stanford was due in part to the fact that there is deposited there documentary material relative to the economic side of the war gathered by Mr. Hoover. He will serve as a member of the advisory committee.

The institute will begin work July 1. The corporation will provide $700,000 for its support for ten years.

The university has agreed to make its scientific laboratories available to the institute. It is not intended to duplicate the equipment of research laboratories working in the field of nutrition, but to cooperate with other agencies.

Need for continual research work in problems arising after food has left the farmer's hands was emphasized by experience during the war, it is explained, when the study of food supply was necessary to attain maximum efficiency in the nutrition of the nations involved. During the war much of the previous data regarding food was found to be inaccurate. It

now is hoped to eliminate waste through scientific research.

Under the terms of the agreement Leland Stanford will appoint three scientific men, with authority to determine policies and problems to be studied. There also will be an advisory committee of men of national prominence, representing agriculturists, consumers, business men and other groups. The university will appoint seven members of this body to serve with the president of the university and the president of Carnegie Corporation, *ex officio,* for a term of three years.

SCIENTIFIC NOTES AND NEWS

The Bruce gold medal of the Astronomical Society of the Pacific has been awarded for the year 1921 to M. Henri Alexandre Deslandres, director of the Astrophysical Observatory of Meudon, France, for his "distinguished services to astronomy."

Professor Jules Bordet, to whom the Nobel prize in medicine was recently awarded, has been elected a member of the senate of Belgium from the Hainaut district.

We learn from *Nature* that at a meeting of the award committee, consisting of the presidents of the principal British engineering institutions, the first triennial award of the Kelvin gold medal was made to Dr. W. C. Unwin, who was, in the opinion of the committee, the most worthy to receive this recognition of preeminence in the branches of engineering with which Lord Kelvin's scientific work and researches were closely identified. The Kelvin gold medal was established in 1914 as part of a memorial to the late Lord Kelvin and in association with the window placed in Westminster Abbey in his memory by British and American engineers.

George C. Whipple, professor of sanitary engineering in the Harvard Engineering School, has been elected a fellow in the Royal Institute of Public Health.

The Medical Society of the City and County of Denver has appointed a committee to plan a meeting in appreciation of Dr. Hubert Work, Pueblo, the president-elect of the American Medical Association.

Dr. J. M. Aldrich, of the U. S. National Museum, was elected president of the Entomological Society of America at the Chicago meeting.

Professor George A. Dean, of the Kansas State Agricultural College, was elected president of the American Association of Economic Entomologists at its recent annual meeting in Chicago.

Dr. W. R. G. Atkins, of Trinity College, Dublin, has been appointed head of the department of general physiology at the Plymouth Laboratory of the Marine Biological Association.

We learn from the *Journal* of the Washington Academy of Sciences that Mr. W. F. Wallis, of the department of terrestrial magnetism, Carnegie Institution of Washington, left Washington on January 9 for Huancayo, Peru, where he will succeed Dr. Harry M. W. Edmonds as magnetician-in-charge of the Huancayo Magnetic Observatory upon the conclusion of the latter's two-year assignment. Dr. Edmonds will return about April *via* San Francisco for duty at Washington.

Dr. H. L. Shantz has been appointed plant physiologist in charge of plant physiological and fermentation investigations in the Bureau of Plant Industry. Dr. Shantz returned in September from a year's trip through Africa for the Office of Foreign Seed and Plant Introduction.

Mr. A. D. Wilson, who has been director of agricultural work for the University of Minnesota for the past twelve years and superintendent of Farmers' Institutes for the State of Minnesota for the past fourteen years, has resigned these positions to take up farming in northern Minnesota, the resignation being effective on June 30.

Mr. W. H. Kenety, who has been assistant professor of forestry in the University of Minnesota and superintendent of the Forest Experiment Station at Cloquet for the past eight years, has resigned to take a position

with a commercial wood products utilization company.

DR. EDWARD A. SPITZKA assumed his new work in the neuro-psychiatric section, medical division, War Risk Insurance Bureau, Washington, D. C., on March 1.

DR. HORACE W. FRINK, assistant professor of neurology at the Cornell Medical College, has sailed to work in psycho-analysis with Professor Freud at Vienna.

PROFESSOR SELSKAR M. GUNN, formerly associate professor of public health at the Massachusetts Institute of Technology, who has served for three years as associate director of the Commission for the Prevention of Tuberculosis in France, has left for Prague, Czechoslovakia, where he is to act as adviser in Public Health to the Ministry of Public Health. This appointment is in connection with the program of cooperation between the International Health Board of the Rockefeller Foundation and the Ministry of Public Health.

A MEMORIAL lecture on the life and work of the late Sir William Abney will be delivered before the Royal Photographic Society of Great Britain by Mr. Chapman Jones.

As a tribute to the services and character of the late General William C. Gorgas, the Senate has ordered that the remarks made at the memorial services in his honor, held at Washington, D. C., January 16, be printed.

UNIVERSITY AND EDUCATIONAL NEWS

THE sum of $1,000,000 has been given to the new School of Medicine and Dentistry of the University of Rochester, by Mrs. Gertrude Strong Achilles and Mrs. Helen Strong Carter, daughters of Henry A. Strong, who died in Rochester in 1919. The money will be used toward the erection of a clinical hospital as a memorial to the father and mother of the donors.

THE *Bulletin* of the American Mathematical Society announces that in the department of mathematics at the University of Illinois, Associate Professor R. D. Carmichael has been promoted to a full professorship; Dr. C. F. Green, Dr L. L. Steimley, and Dr. B. Margaret Turner have been appointed instructors; Professor E. R. Smith, on leave of absence from Pennsylvania State College, has been appointed associate.

DR. RHODA ERDMANN, formerly lecturer at Yale University, has been appointed lecturer on experimental cytology in the University of Berlin.

AT the University of Cambridge Dr. W. L. H. Duckworth, Jesus College, has been appointed to the newly created readership of anatomy, Mr. F. A. Potts, Trinity Hall, demonstrator of comparative anatomy, V. C. Pennell, Pembroke College, an additional junior demonstrator in anatomy and Dr. C. S. Myers, Gonville and Caius College, has been appointed reader in experimental psychology.

DISCUSSION AND CORRESPONDENCE

HUMAN NATURE AS A REPEATING FACTOR: THAT THRICE TOLD TALE

THE following comments on Professor Wood's "Thrice Told Tale," SCIENCE, January 14, 1921, are based upon my long experience in showing celestial objects through a great telescope to tens of thousands of Saturday-night visitors, and in explaining photographs of star clusters, the Milky Way, spiral nebulæ, etc., to thousands of others. Perhaps these comments will be of interest to the psychologists.

I fear that Professor Wood is unduly concerned about the victimization of present-day expositors of the universe, including himself. Contrary to his implication that the response to his (Wood's) explanation of the universe, made by the chance visitor to his ingenious telescope, could never be made again, I would say that the incident in all its essentials has certainly happened many times, and it will doubtless occur many times in the future, for human nature is a first-class repeating factor.

When visitors to an observatory get a sudden appreciation of the bigness of our sun and other stars, of the number of suns in our stellar system, of the possible number of

planets revolving around those suns, of the strong probability that intelligent life exists in abundance throughout the universe, of the number of the spiral nebulæ, of the probable sizes and masses of the spirals, etc., they frequently react with the comment that, if what the astronomer says (of the universe) is true, it doesn't matter much whether we (the people of the nation or the peoples of the earth) do this or do that. Their "this" and their "that" are generally dictated by the subject which happens to be uppermost in the public mind at the time. If our country is thoroughly interested in the presidential campaign, as it certainly was in the struggle of June, 1912, what is more natural than that Professor Wood's lone visitor should not be the only person to illustrate his philosophy by turning to that absorbing question of the day? And so, following a sudden comprehension of the extent and contents of the universe, our Hercules cluster visitor reacted, "I think it doesn't matter very much whether Roosevelt or Taft is nominated at the Chicago convention;" and G. Lowes Dickinson's lone telegraph operator in a railroad shack in the Rockies reacted, "I guess it doesn't matter two cents after all who gets elected president."

Other visitorial reactions here have drawn upon other subjects occupying the public mind, but there is no call to describe them now.

I recently asked one of my colleagues who has dealt extensively with the visiting public in the past twenty-six years whether he has had any experience bearing on this subject. He replied: "I have on several occasions drawn visitors' responses paralleling the incident described in your address. I have observed this reaction, not only in connection with visitors to the observatory, but from members of audiences to which I have lectured. Last month I delivered a short lecture to the patients in the tubercular hospital at Livermore, California, on 'Life in other worlds,' making references to the great number of suns in our stellar system, the possible multitudes of planets revolving about those suns, and the probability that many of those planets are inhabited. At the close of the lecture one of the patients came up to me and said, 'After listening to your lecture, I don't think it matters much whether we patients get well or not.'"

I am respecting the value of understatement in saying that the essential parts of Professor Wood's story have happened here many times in the past thirty-three years in connection with the more than 200,000 visitors whose ideas of the universe have been enlarged in an immense number of cases by looking through the telescopes or by listening to the interpretation of astronomical photographs. I hope it is also an understatement to say that my experience in dealing with the public along this interesting psychological line seems to have been somewhat more extensive than that of others who have written on the same subject.

May I turn from these natural happenings to an incident truly astonishing? In some well-known book I have read of a human being who, looking at the moon through a telescope, was told that the large ring-formation in view was the crater Copernicus (or possibly Tycho or Archimedes—I can not locate the passage now), and who said to his instructor, "I should like to know how astronomers discovered that the name of that crater is Copernicus." This imaginary event is widely known in astronomical circles, but no one, in my opinion, had thought that it actually happened or even could happen. Yet, one Saturday night in the nineties a visitor descending from the observing chair said to me in all seriousness and innocence, "I was able to follow your description of the moon's surface, but I should like to have you tell me how astronomers discovered that the name of that large crater is Copernicus." If this unnatural incident could repeat, why waste energy and ink over the hypothesis that Wood's neighbor, acting in accord with widely prevailing philosophy, was a genuine unique?

W. W. Campbell

Mount Hamilton, California,
February 17, 1921

GALILEO AND WOOD

To the Editor of Science: I have long been interested in horns, and I should dearly

like to blow a blast on a David Wilbur Horn. To him I will say merely "Quis custodiet ipsos custodes?" Let the chemist take heed when murdering romance lest he also murder Cicero. I beg to associate myself with that veteran story-teller, T. C. Mendenhall, whose stories were so good that it never occurred to any one to doubt them.

I will take a little whack at the Galileo story myself, after relating my experience with the Wood story. In the summer of 1912 I was on the train going from London "up" to Cambridge with the guests for the quarter millenium of the Royal Society when I heard Dr. Nicholas Murray Butler telling it to Sir Oliver Lodge, and I assisted him, as Professor Wood had told it to me several years before as having happened at Easthampton. What was my surprise then at seeing Professor Campbell's account as happening later at the Lick Observatory! I immediately wrote him and Professor Wood. In my opinion Wood's story is the better, but I never could believe that the definition in that revolving mercury paraboloid could be good enough for a farmer to make such an observation. I always felt that this telescope in the well was one of Professor Wood's jokes. It was particularly wooden. Perhaps Professor Wood will pardon me if I insert some lines that I wrote in his guest book expressing my feelings on the subject. It will easily be seen that I am no great poet.

> Ding, dong, bell,
> Prof is in the well.
> What did he put in?
> Lots of time and tin.[1]
> What did he get out?
> Nothing, just about.
> What a silly prof was that,
> He never knew what he was at.

I am bound to admit that the Royal Society did not agree with me when they elected him a foreign member.

As for Galileo, some years ago I was invited to deliver an address at the dedication of a new physical laboratory at a great university not a thousand miles from here. Supposing I was to be "the big noise" I prepared an address about an hour long, but was somewhat disconcerted on being introduced by the dean in an address of about half an hour, in which much of the wind was taken out of my sails. In it he used the words, "When Galileo dropped the two weights from the tower of Pisa he sounded the death-knell of the Aristotelian philosophy." Singularly enough the same sentence occurred in my address. But I had my revenge. In beginning I disclaimed all possibility of thought-transference, and when I came to the quoted words I added "as Sir Oliver Lodge says." I was rewarded with roars of laughter, and when I arrived at the club was told that the joke was much appreciated, as the dean was not popular. The joke would have been on me, however, if my manuscript had been looked at, for no more than the dean had I given Lodge credit for the remark that we both had cribbed. He laughs best who laughs last, for the dean is now president of that great university, while the subscriber is even less of a noise that he was then. However, hurrah for history! was it Napoleon who called it "mensonges convenus"?

Arthur Gordon Webster

Worcester, Mass.,
February 13

[1] Poetic for mercury.

ARCHEOLOGICAL SPECIMENS FOR MUSEUMS

The curator of the Museum at Phillips Academy has received authority from the trustees to reduce the number of specimens possessed by the department of archeology. We have large numbers of various objects in stone, bone and clay, found during the course of our explorations in New England, the Middle West and the South. We propose assembling collections ranging from 500 to as high as 4,000 specimens, all recorded as to locality from our catalogue, etc., and to send these to museums, natural history societies, etc. There is no condition, but it is requested that certain of the specimens be exhibited. They will be found of value to students. These exhibits have cost us a great deal to accumulate, and while we ask no financial

return, we feel that those who receive the collections should pay the expenses of cataloguing, assembling, packing and shipping. The smaller collections will require several days to prepare and ship, the larger ones one or two weeks. The cost of clerical and other assistance will range from $65 to $200, depending on the size of the collection.

W. K. Moorehead,
Curator

Andover, Mass.

PUBLICATIONS OF THE VIENNA MUSEUM

Dr. Victor Pietschmann, as successor of the late Dr. Steindachner, writes of the sad plight of the museum of Vienna in having no means for publication, and no means of disposing of two works already printed. One of these is a Monograph of the Genus Tenthredo, the other a Monograph of the Siphoneæ Verticillateæ from the Carboniferous to the Cretaceous with plates, by Dr. J. Pia. This great work on fossil plants is said to be of especial value, and Dr. Pietschmann has great hopes that some one in America may take fifty copies at $5.00 each. The price is not great and the crisis is pressing. I suggest that any one willing to help this great center of scientific work to rise to its feet, may (as I have done) send a check for the equivalent in Kroner of five dollars to Dr. Pietschmann, Mechelgasse 2, Vienna 111.3.

David Starr Jordan

QUOTATIONS

THE PROTECTION OF BRITISH OPTICAL INDUSTRIES

There are two main objects which the Bill to be introduced should secure and reconcile. On the one hand, if the industry is to be saved, the manufacturers must be protected from foreign competition aggravated by the state of the exchange; and, on the other, the users of scientific instruments must not be prejudiced or hampered, either by being unable to obtain the best instruments or by having to pay an extravagant price for them. These apparently conflicting interests are not merely reconcilable; they are interdependent. If the British optical industry should dwindle and die, the scientific users of instruments will be at the mercy of foreign manufacturers, they will have to pay a heavy price for such dependence, and they will be handicapped as compared with scientific workers in foreign countries possessing a flourishing scientific instrument industry. Similarly, if the scientific users can not obtain the best instruments for their work, or if they have to pay an exorbitant price for them, their work will be hampered, their demand for instruments will decrease, and the manufacturers will ultimately suffer.

The industries, through the British Optical Instrument Manufacturers' Association, ask shortly for the following measures of protection:

1. No optical glass or scientific instruments to be imported into this country for a period of, say, seven years, except under license.

2. Such licenses only to be granted in respect of goods which are not being made in Great Britain in the required quantities or of the required quality.

3. An expert licensing committee to be set up.

4. The optical instrument manufacturers are prepared, in order to guarantee reasonable prices, to submit to a control of profits.

The manufacturers are satisfied and confident that, under such conditions for a limited period, they would be able to establish the optical glass and optical instrument industries on a sound and stable basis, and also be able at the end of the period to meet any foreign competition in the open market. On the other hand, unless they secure this limited protection, it is more than prabable—indeed, it is almost certain—that the manufacture of optical glass in this country will cease, and that, in consequence, some of the largest British manufacturers of optical instruments will greatly curtail their production. The proposed measures seem to protect adequately the interests of the scientific users. Moreover,

such a system of control of imports for a limited period seems preferable to anything in the nature of a permanent tariff. It is not likely to have on the industry the emasculating effect of a protective tariff; provided that the period be limited, and that the licensing committee adopt an enlightened policy, prohibition of imports, except under license, is rather calculated to act as a stimulus on the development of the industry.

There is, finally, one point not dealt with in the proposals outlined above. In return for this shield from danger during a limited period, the country may well ask: What guarantee is there that the manufacturers are taking due measure to promote and prosecute the scientific research and scientific methods on which alone ultimately these, or any other, industries can be made efficient and able to stand against foreign competition? The leading manufacturers have combined to form a scientific instrument research association, and in addition many of them are engaged continuously in scientific reseach. But it is not clear that all the manufacturers who are demanding the legislative measures outlined above are contributing in either or both of these ways to the advancement of the industry. It is worth considering whether the proposed licensing committee should not take this factor into consideration in any specific case in which it is asked to grant or to refuse a license.—*Nature*.

SCIENTIFIC BOOKS

Mineralogy: An Introduction to the Study of Minerals and Crystals. By EDWARD H. KRAUS AND WALTER F. HUNT. McGraw-Hill Book Co., New York. 1920. 561 pages, about 700 figures.

When a new book enters a field supposed to be already rather thoroughly covered, the first thing that will be inquired about it is, wherein does it differ from previous books? A hasty glance through the present volume yields one answer: in the character and quality of the illustrations. The usual line-drawings of crystals are abundantly supplemented by half-tone views of crystal models, which enable the reader to gain an unusually good idea of the shapes of the crystals described. Then there are portraits of leaders in mineralogy and allied sciences, both past and present, and representing various nationalities. And, finally, there are numerous photographs of mineral specimens, bringing out typical features of the 150 mineral species covered.

Other noteworthy features are a readable chapter on the polarizing microscope, one on gems and precious stones, and one in which the minerals are classified according to elements present, and their uses are discussed. The last 150 pages of the book are devoted to an elaborate determinative table, based on physical properties. Every effort has been made to bring out the practical side of the subject, to show wherein the facts given bear on the everyday experiences of the reader, and to make the subject matter interesting as well as informing.

In certain respects, moreover, the book is more up-to-date than is usual in an introductory text. For instance, in the definition of a mineral, allowance is made for recent discoveries as to variability in composition, and for the occurrence of colloid minerals, thus: "A mineral is a substance occurring in nature with a *characteristic* chemical composition, and *usually* possessing a definite crystalline structure. . . ." Further, a table is furnished for the use of the Merwin color screen in identifying elements by flame tests; and special tests to distinguish calcite from aragonite and from dolomite are given. Modernized formulas are listed for pyrrhotite, limonite, and bornite.

The make-up of the book is on the whole good. The crystal models would have shown up better if they had been coated with ammonium chloride before photographing. There are a number of places in which the type has evidently become pied after the last proof was corrected, but these can be readily set right on reprinting. Through a change in the vowel in the last syllable, the birthplace of scientific mineralogy appears as a castle, rather than the more appropriate mountain; microcosmic

salt becomes microscopic in one place; while phosphorus at least three times shows its affinity for o by taking up this letter into its last syllable; but all of these are changes which occur frequently in the composing room, and are of minor importance. The reviewer would prefer the Latin to the hybrid spelling of sulfur, the name columbium to niobium throughout, and diatomaceous to infusorial earth (since there are no infusoria in it). He also does not believe that classification of minerals by their metals is less scientific than by their non-metals; but that every one does not agree on such matters is an advantage to science, and not a detriment to this book.

To sum up: Because of the excellent illustrations, the up-to-dateness, and the practical nature of the information furnished, there would seem to be room for this "Mineralogy" even in a somewhat crowded field.

Edgar T. Wherry
U. S. Department of Agriculture

SPECIAL ARTICLES

ACID PRODUCTION BY A NEW SULFUR-OXIDIZING BACTERIUM

In a series of investigations on the oxidation of sulfur, which resulted in the isolation of a very strong sulfur-oxidizing bacterium, a striking fact has presented itself, namely, an intense oxidation of sulfur to sulfuric acid and a large accumulation of acids, even in the absence of neutralizing substances.

The organism is autotrophic, *i.e.*, is able to derive its energy not from the decomposition of organic substances, but from the oxidation of sulfur, although the presence of organic substances is not detrimental to its activities. The carbon, necessary for the building up of its body substances, is derived from carbon dioxide of the air. In a medium entirely free from any traces of organic materials and carbonates and containing ammonium salts as sources of nitrogen and some inorganic minerals, the organism rapidly oxidizes sulfur into sulfuric acid; the latter acts upon neutralizing substances present in the medium (tricalcium-phosphate has been used chiefly) transforming them into salts and acid salts; when all the neutralizing substances present have been used up, free acids begin to accumulate.

Free acidity was measured both by titration, using phenolphthalein as an indicator, and by the determination of the concentration of hydrogen ions, using the phonolsulfonephthalein series of indicators added to buffer solutions. For the determination of the highly acid solutions, tropaeolin 00, methyl-violet and mauvein were used and the results checked up by the electrometric method.

The following table is typical of the acid accumulation by the organism:

TABLE I

Age of Culture	P_H	Titration. C.c. of N/10 Alkali Required to Neutralize 1 C.c. of Culture
At start	5.6	0.16
33 days	2.2	1.25
61 days	1.8	2.25
85 days	0.58	4.00

The titration does not give a true indication of the true acidity of the medium, and, although the culture, when 83 days old, was equivalent to 0.4 N acid by titration, the presence of large amounts of soluble phosphates in the medium would tend to diminish the actual free acids in the medium. But the P_H value gives a true indication of the acid concentration of the medium. The highest concentration of acid ever reported for a living phenomenon was the production of citric acid by *Aspergillus niger*, which reaches a P_H equivalent to 2.0–1.8 (Clark and Lubs[1]). The acidity produced by this sulfur-oxidizing organism, as expressed in terms of P_H—0.58—is greater than that of any acidity ever reported for biologic phenomena.

A detailed study on the sulfur oxidation by this organism will soon be published in *Soil Science*.

Selman A. Waksman,
Jacob S. Joffe
N. J. Agricultural Experiment Station

[1] W. M. Clark and H. A. Lubs, *J. Bact.*, 2, 1917, 1–34, 109–136, 191–236.

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

ORGANIC DIVISION

E. Emmet Reid, *chairman*

Roger Adams, *secretary*

The oxidation of propylene glycol by means of alkaline potassium permanganate: W. L. EVANS, J. E. DAY and W. R. STEMEN.

The oxidation of isopropyl alcohol and acetone by means of alkaline potassium permanganate: W. L. EVANS and LILY BELL SEFTON.

The influence of alkali on the formation of vinyl alcohol from acetaldehyde: W. L. EVANS and C. D. LOOKER.

The solubility of dichloro-diethyl-sulfide in petroleum hydrocarbons and its purification by extraction with these solvents: THOMAS G. THOMPSON and HENRY O'DEEN.

Rearrangement of unsaturated acids: OLIVER KAMM and M. E. DREYFUS.

The reaction velocity of dealkylation of tertiary amines with acyl halides: OLIVER KAMM and W. F. DAY.

The alcoholysis of esters with amino alcohols: RUFUS M. KAMM.

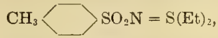
Reactions of the arsines. Condensation of primary arsines with aldehydes: ROGER ADAMS and CHARLES SHATTUCK PALMER. Aromatic aldehydes and aliphatic aldehydes readily condense with phenyl arsine, when a few drops of hydrochloric acid are present, to give products consisting of two molecules of aldehyde and one of phenyl arsine. These substances are stable to water, dilute alkali and acid, and are probably represented by the structural formula given in the following equation:

$$2\ RCHO + RAsH_2 \rightarrow RAs(CHOHR)_2.$$

On the non-identity of α-eleosteric acid from tung oil with ordinary linolic acid: BEN. H. NICOLET. α-eleostearic acid is readily prepared from tung oil (China wood oil). On bromination in glacial acetic acid it is known to form a tetrabromide m. 115° which Lenkowitsch ("Oils, Fats and Waxes," Vol. I.) suggests is identical with linolic acid tetrabromide, m. 114°. A mixed melting point showed a lowering of 15°, so that the two are obviously different. Bromination of the eleostearic acid in ligroin leads to the formation of a dibromide, with altogether different properties.

A new type of nitrogen-sulfur compounds; the action of chloramine-T on organic sulfides: BEN. H. NICOLET and IMOGENE D. WILLARD. On boiling together in alcoholic solutions diethylsulfide $(C_2H_5)_2S$ and chloramine-T,

give NaCl and a compound which is probably



since it is hydrolyzed to give p-toluenesulfonamide, and a product which on reduction gives diethylsulfide and which is presumed to be diethylsulfoxide. The reaction is believed to be rather general. Compounds containing N and S linked by a double bond, have been practically unknown.

Report on the progress of the manufacture of research organic chemicals: HANS T. CLARKE. The present report covers the work of this department of the Eastman Kodak Company during its second year of activity. As was to be anticipated, the progress made has been very much greater than during the first year as regards both the number of chemicals available and quantities distributed. At the present time nearly 800 different chemicals are available, almost all of these being organic, the balance consisting of certain inorganic chemicals employed principally in organic work. Of these 800 substances, about 600 have been prepared in our laboratory, some by purification of materials technically available, but the majority by synthesis. Over 600 different preparations have been undertaken, almost all of which have ultimately been successful. In a certain number of instances more than one product is obtained, either as a by-product or as an intermediate stage. A good deal of time is naturally now being spent upon the renewal of depleted stocks by methods which have already been developed in the laboratory, but the preparation of new compounds is still regarded as being a most important part of our work. Between 10 and 20 new chemicals are added to the list every month, and these are announced in the advertising columns of certain of the scientific periodicals. A file is kept of the names of materials for which inquiry is made, and this is constantly before us in the selection of new preparations. As soon as any chemical for which such inquiry has been made is available, the fact is made known to the party from whom the inquiry was received. It is in many cases difficult to decide whether or not a specific chemical should or should

not be prepared. A large number of inquiries are received for chemicals which we could never hope to furnish; in some instances, the preparations could be undertaken, but it is questionable whether the time devoted to working out the method and preparing a stock might not be better applied to some problem for which there is greater urgency. Our desire is to serve the research chemists of the United States, but to do this to best advantage it is necessary to consider the interest of the greatest number. We acknowledge with gratitude the continued support of the chemical manufacturers, who have supplied us not only with their regular products, but often with those which are available in quantities too small to place on the open market. The amount of chemicals sold continues to increase slowly but steadily, and the department is now almost self-supporting. It is at present being transferred to new laboratories especially designed and erected for the work, and it is expected that greater efficiency will be possible than in the improvised laboratory where the work was begun.

The production of benzoic acid and benzophenone from benzene and phosgene: Robert E. Wilson and Everett W. Fuller.

The nature of the reactions of anilines upon nitrosophenol: Carleton E. Curran and C. E. Boord. Experimental evidence shows that the first reaction product between aniline and nitrosophenol is quinone phenylhydrazone. Dilution or neutralization of the reaction mixture converts this substance into its tantomer phenyl-azophenol. Subsequent action of aniline upon the quinone-phenylhydrazone converts it into mono-anilino quinonephenylhydrazone, dianilino quinone and azophenine, in turn. The theory is proposed that the formation of indamines by the action of anilines upon nitrosophenol is due to the semidine rearrangement of quinone-phenylhydrazones.

Reduction of polynitrophenols by hydrogen sulphide in the presence of ammonia: L. Chas. Raiford. In the preparation of starting material with which to test further the migration of acyl noted in a previous paper (*Jour. Am. Chem. Soc.*, 41, 2068 (1919)), with a view to determining the effect of acid-forming substituents in the aminophenol 2, 4-dinitrophenol was reduced by hydrogen sulphide in the presence of ammonia in the usual way. Contrary to what has heretofore been reported, isomeric substances were obtained. Work is in progress to determine the effect of other substituents (compare Anschutz und Heusler, *Ber.*, 19, 2161 (1886)).

The action of ammonia and substituted amines on allophanic ester: F. B. Dains and E. Wertheim.

Hydrazoisopropane: H. L. Lochte and J. R. Bailey.

A convenient method for preparing certain bromohydrins: J. B. Conant and E. L. Jackson.

Addition reactions involving an increase in vaence of a single atom: J. B. Conant.

New derivations of thymol and carvacrol: D. S. L. Sherk and Edward Kremers. The quinhydrone hypothesis of plant pigments, as it grew out of the biochemistry of the Monardas, necessitated a revision of the underlying compounds. This study has been continued, especially along the line of intramolecular changes such as manifest themselves in connection with the nitroso compounds of the above mentioned phenols and their isonitroso rearrangement products.

The action of amines upon thymoquinone: Nellie A. Wakeman and Harlan G. Groffman. Dimethylamidothymoquinone, prepared according to Zincke, yields a platinic chloride double salt containing 41 per cent. of platinum, corresponding to the union of one molecule of the base with two of acid platinic chloride. Thymoquinone treated with benzylamine, in alcoholic solution, yields dibenzylaminothymoquinone, with some mono-benzylaminothymoquinone. Thymoquinone with aniline, also with p-toluidine, under the same conditions, yields the di- derivative. No mono- derivatives have been isolated here. Thymoquinone with piperidine, under the same conditions, yields a pale purple crystalline derivative, the constitution of which has not yet been determined.

Organic mercury compounds of phenol: Frank C. Whitmore and E. B. Middleton.

Charles L. Parsons,
Secretary

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CONTENTS

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THE FUTURE OF MINERALOGY IN AMERICA[1]

INTRODUCTION

This meeting is the culmination of repeated efforts extending over a period of more than one hundred years to band the mineralogists of America together and to maintain a journal devoted primarily to mineralogy and cognate sciences. Although our colleagues in England and France organized over forty years ago, in 1876 and 1878, respectively, we were unable to do so until a year ago. The past year has been primarily one of adjustment and development and of bringing the need of such an organization more strongly to the attention of those interested. It has also been a period during which our ideas of what the society should be have become somewhat clarified. The progress made has been most gratifying. We are now a going concern with some very tangible assets, and there are already strong assurances of a most influential future. As retiring president, I desire to discuss briefly some of the important phases in the development of mineralogy in America, and the various efforts made to organize a national society, and to found a journal; also to interpret, if possible, the function of mineralogy in our present-day educational and scientific programs and to indicate some probable lines of future development.

THE PERIOD OF EARLY DEVELOPMENT, 1785–1850

The earliest published papers dealing with the mineralogy of America were apparently those which appeared in the *Memoirs of the American Academy of Arts and Sciences,* in 1785. These were followed two years later by

[1] Address of the retiring president of the Mineralogical Society of America, Chicago, December 29, 1920.

what Merrill characterizes as the first work on American geology although its title was distinctly mineralogical. I refer to Schoepf's *Beitraege zur Mineralogischen Kenntniss von des Oestlichen Theils von Nord Amerika und seine Gebirge,* which was published in Germany.

An event of far-reaching importance upon the development of our science was the appointment in 1802 of Benjamin Silliman as professor of chemistry, mineralogy, and so forth in Yale University. This appears to have been the first college appointment for mineralogy in America. Silliman began his lectures at Yale in the fall of 1804, and two years later wrote a sketch of the "Mineralogy of New Haven," which was published in 1810 in the *Transactions of the Connecticut Academy of Sciences.* In those days mineralogy and geology had not been sharply differentiated, and mineralogy was commonly used as the more comprehensive term. Accordingly, this contribution by Silliman is commonly recognized as the first attempt at a geological description of a region. Mention must also be made here of the "Mineralogical Observations made in the Environs of Boston in 1807 and 1808," by S. Godon, and which were published in the *Memoirs* of the American Academy of Arts and Sciences.

Interest in the subject was increasing rapidly so that in January, 1810, Dr. Archibald Bruce established the *American Mineralogical Journal,* the first American publication designed primarily for mineralogists and geologists. He was a native of New York City, having been born there in February, 1777. Although a physician by profession, Dr. Bruce was vitally interested in mineralogy. After completing his medical studies at the University of Edinburgh in 1800, he spent two years visiting important mineral localities and collections in England, France, Switzerland and Italy, so that when he returned to New York in the fall of 1803 to take up the practise of medicine he brought with him a mineral collection of great value.

Dr. Bruce's biographer tells us that

> the ruling passion in Dr. Bruce's mind was love of natural science and especially of mineralogy. Toward the study of this science, he produced in his own country a strong impulse, and he gave it no small degree of eclat. His cabinet, composed of very select and well characterized specimens; purchased by himself, or collected in his own pedestrian or other tours in Europe, or, in many instances, presented to him by distinguished mineralogists abroad; and both in its extent, and in relation to the then state of this country, very valuable, soon became an object of much attention. That of the late B. B. Perkins, which, at about the same time had been formed by Mr. Perkins in Europe, and imported by him into this country, was also placed in New York and both cabinets contributed more than any causes had ever done before to excite in the public mind an active interest in the science of mineralogy.

And further,

> Dr. Bruce manifested a strong desire to aid in bringing to light the neglected mineral treasures of the United States. He soon became a focus of information on these subjects. Specimens were sent to him from many and distant parts of the country, both as donations and for his opinion respecting their nature. In relation to mineralogy he conversed, he corresponded extensively, both with Europe and America; he performed mineralogical tours; he sought out and encouraged the young mineralogists of his own country, and often expressed a wish to see a journal of American mineralogy upon the plan of that of the School of Mines at Paris. This object, as is well known, he accomplished, and in 1810, published the first number of this work. Owing to extraneous causes, it was never carried beyond one volume; but it demonstrated the possibility of sustaining such a work in the United States, and will always be mentioned in the history of American science, as the earliest original purely scientific journal in America.

It is to be sincerely regretted that the failing health and early death of Bruce caused this journal to be so short-lived. Its continuation would have permitted the mineralogists of this country to have looked with pride upon the achievements of our early workers in this direction, for in Europe much progress in the founding of mineralogical journals had already been made. In France there was the *Journal des Mines,* founded in

1795 and which became the *Annales des Mines* in 1816. In Germany the *Taschenbuch fuer die gesammte Mineralogie mit Hinsicht auf die neuesten Endeckungen* was established in 1806, which subsequently was superseded by the *Zeitschrift fuer Mineralogie.* This journal in turn gave way to the *Jahrbuch fuer Mineralogie, Geognosie, Geologie, und Petrefaktenkunde* in 1830, which with but slight modifications in the title has continued down to the present day and is recognized as a most powerful influence in the development of the early sciences, especially in Europe.

The first comprehensive work on mineralogy in America was Parker Cleaveland's "Elementary Treatise on Mineralogy and Geology," a volume of 668 pages with numerous crystal drawings and a colored geological map of the eastern portion of the United States, which appeared in 1816. In writing this text it obviously was necessary for Cleaveland, who was professor of mathematics and natural philosophy, and lecturer on chemistry and mineralogy in Bowdoin College, to which position he had been appointed in 1805, to draw freely upon European writers, especially English, French and German. The incorporation of American localities was an arduous task, for Cleaveland indicates that Bruce's *Mineralogical Journal,* a paper by S. Godon in the *Memoirs of the American Academy,* and another by Dr. Adam Seybert, of Philadelphia, in the *Medical Museum* were almost the only printed authorities which he employed.

In his introduction, Cleaveland stresses the importance of mineralogy in the following manner:

> It may also be remarked that several arts and manufactures depend upon mineralogy for their existence; and that improvements and discoveries in the latter can not fail of extending their beneficial efforts to the aforementioned employments. In fine the study of mineralogy, whether it be viewed as tending to increase individual wealth, to improve and multiply arts and manufactures and thus promote the public good; or as affording a pleasant subject for scientific research, recommends itself to the attention of the citizen and scholar.

Also,

> But whatever progress may hitherto have been made in mineralogical pursuits, every new advance has opened a wider and more interesting prospect. The science is still in its infancy, and in many of its paths can only proceed with a faltering and uncertain step.

In reviewing this pioneer text, Professor Silliman in 1818 said:

> In our opinion, this work does honor to our country and will greatly promote the knowledge of mineralogy and geology, besides aiding in the great work of disseminating a taste for science generally. . . . The method of execution is masterly. Discrimination, perspicuity, judicious selection of characters and facts, a style chaste, manly, and comprehensive, are among the attributes of Professor Cleaveland's performance. . . . In our opinion, Professor Cleaveland's work ought to be introduced in all our schools of mineralogy and ought to be the travelling companion of every American mineralogist.

The text was received with great favor, a second edition in two volumes being issued in 1822. Although later a third edition became necessary, it was never prepared on account of the failing health of the author.

In 1825 Samuel Robinson published an elaborate list of American mineral localities, entitled "A catalogue of American minerals with their localities." The following year Emmon's "Manual of Mineralogy and Geology" was issued. This was a text of 230 pages. The part dealing with mineralogy was the second general treatise on mineralogy published in America. Little attention was given to crystallography. Descriptive mineralogy was emphasized and 297 minerals were described.

The next work on mineralogy by an American was the first part of the "Treatise on Mineralogy," published in 1832, by Professor C. U. Shepard, who at that time was an assistant to Professor Silliman at Yale University. It was based on the work of Mohs and was a small volume of 256 pages. This was followed in 1835 by Part Two consisting of two volumes of 630 pages. A second edition was published in 1844.

The year 1837 is memorable in the annals of American mineralogy on account of the publication in that year of Dana's "System of Mineralogy." While this work, consisting of 580 pages, was based to a considerable extent on the writings of European mineralogists, notably Haüy, Mohs, and Naumann, it was not devoid of originality. This is especially true of the section on mathematical crystallography and of the elaborate classification of minerals based upon the systems in use in botany and zoology. As it is well known, this system of classification gave way in the fourth edition, in 1854, to a chemical classification which has continued in quite general use down to the present time. Dana's "System of Mineralogy" was received with great favor, and the first edition was succeeded by others as follows: second in 1844, third in 1850, fourth in 1854, and fifth in 1868. The last edition, which is the sixth by E. S. Dana in 1892, with its various appendixes, is the standard reference work the world over on descriptive mineralogy.

As already indicated, in 1810 Bruce founded *The American Mineralogical Journal* which was discontinued after the publication of but one volume. Although but short-lived, it had demonstrated the great need of a strictly scientific journal. Consequently in 1817 Colonel George Gibbs, one of the most enthusiastic devotees of mineralogy and the possessor of perhaps the largest and most notable mineral collection in America at that time, which was purchased by Yale University in 1825, suggested to Professor Benjamin Silliman that a general scientific journal be established. This led to the founding of the *American Journal of Science* in 1818 under the editorship of Silliman. While its scope was intended "to embrace the circle of the physical sciences and their application to the arts, and to every useful purpose," the *American Journal of Science* has from the beginning published most of the important contributions on mineralogical subjects by American writers.

The decade 1810 to 1820 is an extremely important one to us, for during that period there were founded the *American Mineralogical Journal* and the *American Journal of Science.* There was also published Cleaveland's *Mineralogy.* However, it yet remains to call attention to the fact that in 1819 there was organized at Yale College the *American Geological Society.* Many of the members of this society can be characterized as mineralogists, and mention may be made in this connection of Gibbs, Silliman, Cleaveland and Godon. This organization continued until 1828, when it went out of existence. During this period, however, it did much to stimulate American workers in geology and mineralogy.

This organization was followed in 1840 by the *Association of American Geologists,* which held its first meeting in Philadelphia on April 2, 1840. Meetings were held annually and in 1843 the *Transactions of the Association of American Geologists and Naturalists* appeared. However, in 1847 this organization became the *American Association for the Advancement of Science.* It is thus seen that the American Association with which practically all the important scientific societies are now affiliated, was according to Alexander Winchell "in its incipiency a body of geologists, and its first constitution was prepared by geologists assembled in Boston, in 1847."

In the development of American higher education in the period prior to 1850, the fact must not be overlooked that no college or university considered itself adequately equipped unless it possessed a representative collection of minerals. Indeed in the case of some institutions mineral collections, or cabinets as they were commonly called, were usually among the first purchases authorized by the governing bodies of the institutions. Such was, for example, the case at the University of Michigan, which was founded on March 18, 1837, but was not formally opened for instruction until 1841. In the meantime, however, the well-selected mineral collection of Baron L. Lederer, of New York City, consisting of 2,600 specimens, mostly from foreign localities, was purchased. This admirable collection was moreover quickly augmented, so that when the university opened

its doors to students a collection of approximately 5,000 entries was available.

It will also be recalled that in 1807 Yale University acquired the Perkins collection, and that in 1825 the Gibbs collection also became the property of that institution. In discussing the growth of mineralogy in this country from 1818 to 1918, Ford says,

> There is no doubt but that the presence at this early date of this large and unusual mineral collection had a great influence upon the development of mineralogical science at Yale and in the country at large.

From the foregoing discussion it is quite obvious that mineralogy played a very important rôle in the development of higher education during the first half of the nineteenth century. It was one of the first sciences to find a place in the curricula of our colleges and universities. Its devotees founded the first general scientific journals, one of which has continued uninterruptedly up to the present time and is held in high esteem the world over. Mineralogists were also among the first to recognize the need and value of national organizations, and were important factors in the founding of our most general scientific society, the *American Association for the Advancement of Science.*

THE PERIOD OF EXPANSION, 1850–1900

The second half of the nineteenth century was a period of rapid development in higher education. Colleges and universities sprang up all over the United States in quick succession, especially in the mid and far west. It was also a period in which mineralogy and geology were applied practically on a very large scale by the federal and state surveys. The demand for competent geologists became very great, so that more emphasis was now placed upon geology than upon mineralogy by the institutions of higher learning. However, during the last two decades of the century the need of specialization became imperative and the number of scientifically trained mineralogists increased materially. It was during this period also that petrography and economic geology began to be recognized as independent disciplines.

Not only did the expansion of our surveys and the development of our vast mineral resources, but also the fostering of graduate work by our older and larger universities, demand adequately trained specialists. It will be recalled that during the eighties and early nineties comparatively large numbers of Americans went to Europe and especially to Germany, to acquire the latest methods in petrography and mineralogy.

After the *Association of American Geologists and Naturalists* in 1847 voted to resolve that organization into the *American Association for the Advancement of Science,* geology participated along with other sciences in the activities of the association, and with geography formed what is known as Section E. Although at first the *American Association* served the interests of the geologists rather satisfactorily, nevertheless with the rapid growth of the *Association* the opportunities for meetings of a strictly scientific character became fewer and the need of a separate organization began to be felt. According to Alexander Winchell an independent organization was first openly agitated by the geologists assembled at the meeting of the *American Association* at Cincinnati in 1881. Although a committee was appointed, which canvassed the situation and reported favorably upon the organization of a separate society and the establishment of a geological magazine, no definite action was taken at the next meeting.

However, this question continued to be considered quite regularly at successive annual meetings of the *Association* and the publication of the *American Geologist* was begun in Minneapolis in January, 1888. Again on August 14, 1888, in Cleveland, it was resolved that the formation of an *American Geological Society* was desirable, and organization plans were made. The first meeting was held in Ithaca on December 27, 1889, with a membership of 137. This organization, officially known as the *Geological Society of America,* was from the beginning independent and in no way subor-

dinate to the *American Association.* It at once became a great stimulus to American geology and has exerted profound influence upon its development.

During the last two decades of the nineteenth century the movement to band those interested in minerals together in local organizations manifested itself in several of our large cities. Thus in 1886 the *New York Mineralogical Club* was organized to "develop and maintain an interest in mineralogy, especially in the minerals and rocks of Manhattan Island, New York City, through collecting and the study and comparison of existing collections." The club has been successful in stimulating interest in mineralogy in New York City and its environs. It has also acquired the Chamberlain collection of minerals which is now deposited in the American Museum of Natural History. Reference must also be made of the fact that in 1892, what is known as the *Philadelphia Mineralogical Society,* was organized, its purpose being similar to that of the New York Club. From time to time similar organizations had been founded in other localities, all of which have done much to stimulate interest in minerals and especially of those of the region immediately surrounding the location of the society.

It was also during this period that a journal devoted to the interests of the lover of minerals was founded in 1885 by Mr. Arthur Chamberlain. It was first called the *Exchangers' Monthly* but was subsequently changed to the *Mineralogists' Monthly.* In 1892 *Goldthwaite's Minerals* was published. For two years both of these publications appeared but in 1894 they were merged into the *Mineral Collector,* which continued to appear regularly until March 1909 when it was discontinued.

THE MODERN PERIOD, 1900–1920

The first two decades of the twentieth century have been a period of enormous development in higher education. Attendance upon our colleges and universities has increased by leaps and bounds. The physical plants of these institutions were greatly extended. The older departments of instruction were materially expanded by the giving of more advanced and specialized courses, and many new departments were added. Our graduate work developed rapidly. Even before the outbreak of the World War, fewer and fewer students each year found it necessary to go to Europe, as had been the custom during the nineteenth century, for they were now able to secure the instruction desired in our universities. Indeed, this instruction could be obtained from equally competent men and in more modern laboratories with superior facilities than were to be found abroad. The many contributions by the various governmental bureaus and the establishment of the Geo-physical Laboratory in 1907 gave a great impetus to many branches of science in America. Industrial corporations also recognized the imperative need of adequately equipped laboratories and competent investigators.

During this period, the development of science was indeed marvelous. This statement applies to no science more than it does to mineralogy, by which term we obviously include what may be readily interpreted as the broader field, namely crystallography. Moreover, it was during the war that the preeminent position of the United States in the production of minerals and mineral products, and the vastness of our mineral resources were brought most forcibly to the attention of the general public. Mineralogical methods had to be resorted to in the solving of many special problems imposed by the war, when it became necessary for us to establish our scientific independence. Hence, at present the value of mineralogy is appreciated as never before. On account of its basic value in the training of the geologist, chemist, pharmacist, forester, mining engineer, ceramist, and many other specialized engineers and technologists, mineralogy has become in some of our larger and more progressive institutions what may be designated as a "service" science. Furthermore, it is no longer merely a descriptive science but by virtue of the development of many quantitative methods and especially as the re-

sult of the epoch-making discoveries in the field of crystal structure it is now an exact science of fundamental importance.

THE MINERALOGICAL SOCIETY OF AMERICA

During the first fifteen years of the existence of the *Geological Society of America,* comparatively few of its members were primarily interested in mineralogy. However, beginning with the latter half of the first decade of the twentieth century the number of professional mineralogists who became members of the society increased rapidly. This group, however, soon felt that aside from the social aspect of the meetings, the society offered them but little in their own field. Accordingly in January, 1913, Professor Alexander N. Winchell, of the University of Wisconsin, in a letter addressed to those especially interested in mineralogy and petrography, raised the question as to the advisability of organizing a *National Association of Mineralogists and Petrographers.* The responses were, however, of such a character that a postponement of a separate organization was decided upon. This question, however, would not be downed and it came up annually at the meetings of the *Geological Society of America,* so that finally at the Albany meeting, December, 1916, a small group consisting of Phillips, Van Horn, Walker, Wherry, Whitlock, and the speaker, decided to launch an active campaign looking toward the formation of the *Mineralogical Society of America.* A circular letter, signed by the above-named committee, was sent out to those most vitally interested and the replies received clearly indicated the great desirability of such an organization. However, the United States entered the World War in the following April, and consequently plans for organization were held in abeyance. But in the meantime, there had been much correspondence among those taking a lively interest in the organization, and in the fall of 1919 the new society was again actively agitated. A call was issued for an organization meeting to be held at the time of the meeting of the *Geological Society of America* in Boston, and on December 30, 1919, a group of 28 mineralogists met in the Mineralogical Museum of Harvard University and organized the society under whose auspices we are meeting to-day, and adopted a provisional constitution.

At this meeting arrangements were made whereby the lists of charter fellows and members would remain open for one year. The question of affiliation with the *Geological Society of America* was discussed and it is indeed gratifying to know that during the year this has been accomplished. On December 20, the *Mineralogical Society* had 55 fellows and 126 members. There were in addition 139 subscribers to the *American Mineralogist.* The most enthusiastic advocates of an independent mineralogical society never expected that such widespread interest could be stimulated during the organization year.

AMERICAN MINERALOGIST

As already indicated the *American Mineralogist,* which was founded in 1916, became the *Journal of the Mineralogical Society* under the editorship of one of the founders, Dr. E. T. Wherry. A board of associate editors was appointed by the council to assist Dr. Wherry. During the past year the *Journal* has appeared regularly, the earlier numbers being considerably larger in size than had previously been the case. However, on account of increased cost of paper and printing it was necessary to reduce the size of the later numbers. It is hoped that as a result of the general readjustment of prices the issuing of monthly numbers of from 24 to 32 pages each may soon become possible. The exact character of the *Journal* needs to receive the serious consideration of the council, inasmuch as it must serve the widely divergent interests of several groups of the society. We owe much to the energy, skill and unselfish devotion of our editor, who is constantly striving to make the *Journal* one of which American mineralogists may be justly proud. This, however, will require some little time and I trust that we may all be somewhat patient in this matter.

GENERAL OUTLOOK

As the result of a more general recognition of the basic importance of mineralogy in pure and applied science and in various branches of industry, and with a national society boasting of a membership including the progressive investigators and devotees of the subject, and with a well established and widely recognized official monthly publication, the future of mineralogy in America is assured. The problems of really fundamental significance requiring a comprehensive knowledge of crystallography and mineralogy are indeed many. The applications of the methods and truths of our science are constantly increasing and if America is to assume leadership in this great field it can be most speedily and advantageously accomplished through the friendly cooperation of the members of an organization such as this.

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SEX IN THE TREMATODE FAMILY SCHISTOSOMIDÆ[1]

The trematode family Schistosomidæ in addition to containing three species which produce important human diseases, viz., *Schistosoma hæmatobium, S. mansoni,* and *S. japonicum,* is interesting because it is the only group of the trematodes in which the sexes are separate in the adult stage, which lives in the vertebrate. In this stage there is an extreme sexual dimorphism, the structure of the male being adapted for grasping the female in the gynæcophoric canal during copulation and the female having a very long slender body. The complete life cycles of the three human species of this family have been worked out in the last seven years, making it now possible to attack the problems related to the determination of sex and the development of sexual dimorphism.

Just what is involved in these problems can perhaps be made clear by a brief outline of the life cycle of one of the human species of this family, *Schistosoma japonicum.* The adult of this species lives in the bloodvessels of the liver and mesenteries of man and other mammals in the far East. The adults are almost always found in copulation in the vessels of the hepatic portal system. The fertilized ovum develops into the miracidium within the egg shell before the egg escapes from the host. The miracidium hatches almost immediately when the egg is voided into the water and dies within a short time unless it comes in contact with a small species of snail, *Blanfordia nosophora* (Robson). It penetrates vigorously into this snail and metamorphoses into a sac-like structure known as the mother sporocyst. The germ cells of the miracidium are carried over directly into the mother sporocyst and develop by parthenogenesis into daughter sporocysts. A single mother sporocyst may live for a considerable period of time and produce several hundred daughter sporocysts. These daughter sporocysts also carry germ cells and produce by parthenogenesis cercariæ which are the larvæ of the diœcious vertebrate-dwelling adults. These cercariæ escape into the water and will penetrate directly through the skin of any suitable host with which they come in contact. From the skin they make their way to the blood vessels of the liver, where they develop to sexual maturity in about three to four weeks. In fact I have seen copulation in an experimentally infested mouse nineteen days after exposure to these cercariæ.

The first question which naturally arises in connection with the sex phenomena in this life cycle is how far back can the sexual dimorphism be traced in the development of the adult from the cercaria in the final host. In a recent series of studies on the development of *Schistosoma japonicum* in experimentally infested mice I have been able to distinguish males from females in specimens about 0.3 mm. in length. Since the body of the cercaria of this species is about 0.15 mm. to 0.20 mm. in length and the smallest sexually mature forms have a length of about

[1] From the department of medical zoology of the school of hygiene and public health of the Johns Hopkins University.

4 mm. to 5 mm. it can be seen that the sexual dimorphism can be noted at a very early stage. Even in the smaller stages the males have a distinctly larger oral sucker than the females and the body is wider. Also early in development the females show a larger space between the intestinal ceca in front of their point of union than do the males. As development proceeds the differences in size between the suckers of the sexes becomes more distinct. The males become broad and flat and finally the sides of the post-acetabular region curl up to form the gynæcophoric canal. In the females the body tends to become round in cross section and the width is constantly much less than that of males of the same age. A detailed description of this development will be made in a future publication. Fujinami and Nakamura[2] in a paper published in Japanese antedate my findings on early sex dimorphism in *Schistosoma japonicum*. They were able to distinguish the sexes in specimens 0.5 mm. to 0.7 mm. in length, which developed in dogs. They laid especial emphasis on differences in the width of the body and in the character of the intestinal ceca as characters for distinguishing sex.

The next question which arises in this connection is whether sexual dimorphism is present in schistosome cercariæ. Although many workers have made studies and measurements of the cercariæ of the human schistosomes no one has reported such differences. I have myself examined a number of cercariæ of *S. japonicum* with this point especially in mind without noting any dimorphism. Dr. S. Yokogawa, of the Medical College of Formosa, also informs me that he has made an extensive series of examinations and measurements of this cercaria in an attempt to find sexual differences without success. Since the cercariæ of the human schistosomes are very small and can extend and contract their bodies to an unusual extent, slight size differences might escape notice in the living specimens and be difficult if not impossible to detect in measurements of preserved material.

Recently in some studies on a species of schistosome cercaria with eyespots from *Planorbis trivolvis* from Douglas Lake, Michigan, I have been able to demonstrate two distinct size types. This difference in size came to my attention first when I found that the curve plotted from the measurements of cercariæ from a number of infected snails was distinctly bimodal. More extensive studies showed that the cercariæ of this species fell into two distinct size groups. I further found from measurements of the cercariæ from eleven infested snails that in the cercariæ coming from a single snail only one of the size types was represented. The difference in size was so great between these two types that it could be recognized with the naked eye when free-swimming cercariæ of the two types were placed in separate bottles. Measurements of the length of the body of the larger type showed a range of variation from 0.234 mm. to 0.28 mm. while in the smaller type the range was from 0.207 mm. to 0.24 mm. Other measurements of the body and tail, which in this species is unusually large, showed like differences. The adult into which this cercaria develops is not known, although unsuccessful attempts were made to introduce it into ducks and rats. An analysis of its structure, however, places it near to the human schistosomes in the family Schistosomidæ. This relationship means that in all probability in the adult stage of this species the sexes are separate. I therefore interpret the size differences in this species of cercaria as a sexual dimorphism. If this view is accepted the fact that in one infested snail only one of the types of cercaria is represented immediately becomes very significant. A more detailed account of the dimorphism of this species of cercaria will be published later in connection with a study of its structure and activities.

In this connection must be cited the work of Tanabe,[3] on *Schistosoma japonicum*.

[2] Fujinami, A., and Nakamura, H., 1911, "A demonstration of some specimens showing the development of *Schistosoma japonicum*" (Japanese). *Bio ri Gaku Kaishi*, Vol. 1.

[3] Tanabe, K., 1919, "A contribution to the

This author found that in twenty-six out of thirty-one cases when the cercariæ from a single snail were used in infesting experimental animals all the individuals developed were of the same sex. Dr. S. Yokogawa has given me permission to use in this connection the results of some of his experiments along this line, which were performed several years ago. He found that when a cat, dog, or rabbit was infested with the cercariæ from a single snail that worms of only one sex would develop. He also found that in these cases the worms would not develop to maturity. These two workers have developed independently the same hypothesis to explain the results of these experiments.

According to this hypothesis sex in the schistosomes is determined in the fertilized egg and all the cercariæ coming from a single miracidium are of the same sex. When all the individuals derived from the cercariæ from a single snail were of the same sex it would follow that the infestation in this snail was from a single miracidium or two or more miracidia of the same sex. In those cases where both sexes came from the same snail, this snail must have been originally infested with two or more miracidia representing both sexes. Now my findings recorded above in regard to dimorphism in a species of schistosome cercaria, and the presence in one snail of only one of these types, lends further support to this hypothesis. Further, since in the life cycle of *S. japonicum*, the miracidium and the mother sporocyst are the only stages derived from a fertilized egg, it is in these stages that sex differentiation would theoretically be expected. Up to the present time, however, no one has examined these stages to determine whether they show a sexual dimorphism. My purpose in discussing the data given above and the hypothesis derived from them in this preliminary way is to call the attention of zoologists interested in the problems of sex to the interesting condition found in this trematode family.

William W. Cort

knowledge of the morphology and development of *Schistosoma japonicum*" (Japanese). An abstract of a paper given before the Japanese Pathological Society. *Igaku Chuo-Zashi*, Vol. 17, No. 6.

ORIGIN OF POTATO RUST[1]

A year ago the writer called attention to the threatened introduction into the United States of two more crop pests, the potato rust, *Puccinia Pittieriana*, and the peanut rust, *Puccinia Arachidis*.[2] Since then the latter fungus has been found in one field in Florida, where all vestige of it was at once destroyed. The other fungus has not yet appeared in the United States.

During 1918 the potato rust was very abundant and harmful in the experiment station grounds at Ambato, Ecuador, not only upon potatoes but even more so on tomatoes. This was the first report of the rust in South America, having previously been known only from the high lands of Costa Rica on the potato alone. In Ecuador it showed decided preference for North American varieties of the tomato. An excellent illustrated account of the rust and its behavior, with conjectures on its origin, was published in the bulletin of the Ambato station for January, 1920, by the station botanist, Abelardo Pachano.[3] I take the liberty to quote a few disconnected sentences from this article, after changing them from the Spanish into an English garb.

> The rust of the tomato and potato is a wholly new disease, not only in our fields [in Ecuador], but also elsewhere. Not simply the fact of its novelty should interest us, but more particularly its virulence, its ease of propagation, and the enormous injuries that it occasions; these considerations would seem to place it among the most serious maladies of cultivated crops.
>
> The history of this rust [in this region] may be easily sketched. The year 1918 is demonstrated as the date of its first appearance. In fact in the spring of that year we had occasion to observe very grave disturbances, by our horticulturists given the general name of plague, in the tomato plots from seed of North American origin. The varieties most attacked were those by the names Acme, Golden Queen and Black-eyed State. Nearly at the same time we noted similar lesions

[1] Presented to the Mycological Section of the Botanical Society of America at the Chicago meeting, December 29, 1920.

[2] Science, 51: 246–247, March 5, 1920.

[3] *Boletin de Agricultura Quinta Normal*, 1: 7–12, Figs. 1, 2, January, 1920.

in the parcels of potatoes of the variety Calvache. But although the malady has increased very rapidly and is abundant in the tomato plots, it has not flourished in those of the potato.

Where did this new parasite come from? We have not met with it up to the present on any of our wild Solanaceæ, so as to enable us to infer that it has been transferred from them to the potato and tomato; neither has seed been received from Costa Rica so we could believe that it has come from that locality. The trouble, as it has manifested itself, has appeared on plots grown from North American seed, in a way to make us think that this new plague is to be referred to the United States.

Mr. Pachano informs me by letter that the disease was not so prominent during 1919 as it was in 1918, but had the same relative predominance on the tomato, especially on the North American varieties. He has also modified his views regarding its origin. We may assume, I think, that the susceptibility of North American varieties has no special significance in connection with the question of the native host or habitat. The snapdragon rust has been known since 1897, and has spread throughout the United States, but only recently has it been traced to its native Californian hosts. In fact I think we can safely assume that the appearance of the potato rust in the gardens of central Ecuador indicates that the rust can be found on uncultivated native plants in that same region. The Solanum rusts of tropical and semi-tropical America are numerous, but have been little studied, and those of Ecuador almost not at all.

There is a rust described from Colombia on *Sarache edulis,* a close relative of Solanum, which much resembles the potato rust except that it has slightly larger spores. This same rust on another species of Sarache was found in the vicinity of potato rust on Mt. Irazú in Costa Rica by E. W. D. Holway, who tells me that the plant is common in gardens there, going by the name "yerba mora." There is also a very similar rust known on the wild *Solanum triquetrum,* a vine ranging southward from central Texas into the adjacent region of Mexico, but this form has slightly smaller spores than the potato rust. Only actual trial can show if these forms can be transferred from one host to another, and if the size of the spores is in anywise dependent upon the host.

A variation in spore-size apparently dependent on the host is found to occur in the case of the snapdragon rust, and cases of such size variation are known for other species, some of them authenticated by pedigree cultures. The spores from the potato and tomato are remarkably uniform in size. Whether the three forms of Solanaceous rusts here referred to are the same or not, it is fairly safe to predict that the potato rust has originated somewhere between Ecuador and Costa Rica on hosts native to the localities.

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SCIENTIFIC EVENTS

A WORLD ATLAS OF COMMERCIAL GEOLOGY

WITH the growth of American industries the known and the possible sources of our supplies of raw materials have become of greater and more pressing interest. Even the United States—most favored of nations in abundance and variety of raw materials—can not be self-sufficient; it must look beyond its shores for supplies as well as for markets. The study of the distribution of mineral raw materials and their relations to the promotion of trade and the control of industry is a branch of geology and may best be termed commercial geology. Under the complex requirements of present-day life no continent, not even North America, can be self-sustaining. It is no longer enough for us to make an inventory of the mineral wealth of the United States; we must supplement that inventory by a broad understanding of world demand and supply. To set forth graphically and to describe concisely the basic facts concerning both the present and the future sources of the useful minerals is the purpose of a World Atlas of Commercial Geology just

issued by the United States Geological Survey, Department of the Interior.

The output of the essential minerals in 1913, the latest normal year, may at least be regarded as a measure of the "quick assets" possessed by each nation, and the first part of the World Atlas of Commercial Geology has therefore been planned to show the distribution of mineral production in 1913.

The practical value of this exhibit of the world's mineral assets is evident. Experience gained during the World War emphasizes the advantage of an adequate supply of raw materials close at hand, yet that there are certain economic limits to domestic independence in raw materials is clearly shown by the readjustments already made. The more facts we possess bearing upon the relative quantity and the relative availability of the mineral resources of our own and of other countries, the better able will be our captains of industry to decide whence they should derive their raw material. The mines of the United States should be looked upon primarily as tributary to the many mills, shops, and factories in which the skilled labor of the country may find its opportunity for a livelihood. The output of raw minerals measures only the first step in industry.

More than a score of geologists have cooperated in the preparation of this atlas, which was first undertaken during the World War as a part of the task of keeping American industries supplied with raw material and is to be regarded therefore as a by-product of the war-time activities of the Geological Survey.

AWARDS OF THE LOUTREUIL FOUNDATION OF THE PARIS ACADEMY

Among the awards made this year, as we learn from the report in *Nature*, are the following:

(1) 10,000 francs to Charles Alluaud and to R. Jeannel, for the study of the zoological and botanical material collected by them in the high mountains of eastern Africa and for the publication of the results.

(2) 5,000 francs to Jules Baillaud, for the establishment of a recording microphotometer of the type suggested in 1912 by P. Koch.

(3) 3,000 francs to Henry Bourget, director of the Marseilles Observatory, for the *Journal des Observateurs*.

(4) 2,000 francs to Clément Codron, for his researches on the sawing of metals.

(5) 5,000 francs to the School of Anthropology, for the publication of the *Revue d'Anthropologie*.

(6) 4,000 francs to Justin Jolly, for the publication of a work on blood and hæmatoporesis.

(7) 7,000 francs to Louis Joubin, for the publication of the results of the French Antarctic Expedition.

(8) 3,000 francs to the late Jules Laurent, for the publication (under the direction of Gaston Bonnier) of a work on the flora and geography of the neighborhood of Rheims.

(9) 3,000 francs to Henri Brocard and Léon Lemoyne, for the publication of the second and third volumes of their work entitled "Courbes géométriques remarquables planes et gauches."

(10) 2,000 francs to A. Menegaux, for the *Revue française d'Ornithologie*.

(11) 5,000 francs to Charles Nordmann, for his researches on stellar photometry.

(12) 8,000 francs to the Zi-Ka-Wei Observatory, in China (director, R. P. Gauthier), for recording time-signals from distant centers.

(13) 2,000 francs to O. Parent, for his studies on a group of Diptera.

(14) 10,000 francs to G. Pruvot and G. Racovitza, directors of the *Archives de Zoologie expérimentale et générale*, for this publication.

(15) 6,000 francs to Alcide Railliet, for the publication of researches on the parasites of the domestic animals of Indo-China.

(16) 4,000 francs to J. J. Rey, for the publication of a botanical geography of the Central Pyrenees.

(17) 10,000 francs to Maximilien Ringelmann, for researches relating to the physical and mechanical constants of metals intended to be used in the construction of agricultural machines.

(18) 12,000 francs to the Academy of Sciences, for the establishment of a catalogue of scientific and technical periodicals in the libraries of Paris.

It was pointed out by the council in 1917, that, although the special object of this foundation was the promotion of original research, up to that time requests for assisting work to be carried out according to a well-defined scheme had been exceedingly few in number.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE

The American Society of Tropical Medicine announces a new publication for physicians and research workers, to be known as *The American Journal of Tropical Medicine.* The announcement says:

"The general experience of the medical sciences has fully demonstrated the advantages which accrue from the segregation of special subjects. A central organ for the prompt presentation of articles, that are now scattered over a wide field, or the lack entirely of a proper medium to turn to for publication, will be a great convenience to those interested in the study of tropical diseases, and also serve to stimulate the growth and development of the subject. The purpose of the new Journal will be to serve as a medium for the dissemination of reliable information from every source, with regard to the clinical and other phases of the nature, treatment, and prevention of tropical diseases."

The Journal will be published bi-monthly by the Williams and Wilkins Company, Baltimore, Md. The transactions of the annual meetings of the American Society of Tropical Medicine will be published in the Journal. Various reports, lists of members, and such other information as may be suitable will also appear. Other papers, whether from members or not, will also be published.

The following are members of the editorial staff:

Editor: H. J. Nichols, Medical Corps, U. S. Army, Army Medical School, Washington, D. C.; *Advisory Editorial Board:* B. K. Ashford, Medical Corps, U. S. Army, San Juan, Porto Rico; C. C. Bass, Tulane University, New Orleans, La.; M. F. Boyd, University of Texas, Galveston, Texas; C. F. Craig, Medical Corps, U. S. Army, Army Medical School, Washington, D. C.; George Dock, Washington University; Simon Flexner, Rockefeller Institute, New York City; William Krauss, Memphis, Tenn.; W. D. McCaw, Assistant Surgeon General, U. S. Army, Army Medical School, Washington, D. C.; G. W. McCoy, director, Hygienic Laboratory, U. S. P. H. S., Washington, D. C.; K. F. Meyer, University of California, San Francisco, Calif.; E. H. Ransom, Department of Agriculture, Washington, D. C.; R. P. Strong, Harvard University; A. J. Smith, University of Pennsylvania; E. R. Stitt, surgeon general, U. S. Navy; W. S. Thayer, Johns Hopkins University; E. J. Wood, Wilmington, N. C.; *Ex-officio Advisory Editorial Board, The American Society of Tropical Medicine:* J. M. Swan, president; K. F. Meyer, first vice-president; V. G. Heiser, second vice-president; S. K. Simon, secretary and treasurer; A. J. Smith, assistant secretary and treasurer; George Dock, councillor; C. L. Furbush, councillor; J. F. Siler, councillor; J. H. White, councillor; C. S. Butler, councillor.

THE SCIENTIFIC STAFF OF THE AMERICAN MUSEUM OF NATURAL HISTORY

In appointing the scientific staff of the American Museum of Natural History for 1921, the board of trustees has made a number of changes and promotions, some of which have already been noted in Science. The senior curator of the staff, Dr. Joel A. Allen, has been promoted to be honorary curator of mammals, in order that he may devote his entire time to his researches. Dr. Allen is in his eighty-third year and for more than 35 years has been the head of the department of mammalogy. This relief from the responsibility of administrative work comes as a welcome change to Dr. Allen, who speaks of his new appointment in the following language:

> I wish to express to you, and through you to the board of trustees, my deep appreciation of this honor, and of the privileges accompanying it, thus awarded me. It will be a great solace to me during such time as may remain to me for the prosecution of research work, which I am still able to pursue with unabated zest and pleasure.

The trustees have created a new department designated as comparative anatomy and have appointed Dr. William K. Gregory to the curatorship as a recognition of Dr. Gregory's contributions to anatomy and vertebrate

paleontology, which have been largely carried on at the museum during the 22 years that he has been connected with it. Dr. Gregory will have associated with him in the new department Dr. J. Howard McGregor, who has been appointed associate in human anatomy.

The staff in ornithology, under the leadership of Dr. Frank M. Chapman, has been strengthened by the appointment of Dr. Robert Cushman Murphy as associate curator of marine birds. Dr. Murphy will devote himself particularly to the studies on the birds of the Brewster-Stanford Collection and to the collection which will be obtained by the Whitney South Sea Expedition

The former department of invertebrate zoology has been reorganized as two departments, namely, lower invertebrates and entomology. Dr. Henry E. Crampton has been appointed honorary curator of the new department of lower invertebrates and will confine his attention to his Polynesian researches. Mr. Roy W. Miner is appointed associate curator in charge.

Dr. Frank E. Lutz has been promoted to the curatorship of the new department of entomology.

Further staff changes or promotions are as follows:

PROMOTIONS

Lower Invertebrates: Willard G. Van Name, assistant to assistant curator.

Ornithology: Ludlow Griscom, assistant to assistant curator.

Anthropology: N. C. Nelson, assistant curator to associate curator of North American archeology; H. J. Spinden, assistant curator to associate curator of Mexican and Central American archeology.

NEW APPOINTMENTS

Comparative Anatomy: S. H. Chubb, assistant in osteology.

Public Education: Grace E. Fisher, assistant.

Ichthyology: E. W. Gudger, associate in ichthyology.

Mammalogy: Carl E. Akeley, associate in mammalogy.

Entomology: Herbert F. Schwarz, research associate, Hymenoptera.

The title of the department of physiology has been changed to read department of comparative physiology.

SCIENTIFIC NOTES AND NEWS

At a meeting of the trustees of the Elizabeth Thompson Science Fund, held on February 26, the following grants were voted: Dr. T. Brailsford Robertson, Adelaide, South Australia, $250 for the purchase of a comptometer for use in a statistical study of growth. Dr. Donald Macomber, Boston, $300 for an investigation of the effects of diet on fertility. Dr. W. J. Fisher, Woods Hole, $75 for a study of low sun phenomena (sunrise and sunset and horizon mirage). Dr. H. G. Barbour, New Haven, $300 for an investigation into the heat regulatory mechanism of the body.

Lawrence J. Henderson, professor of biological chemistry, has been appointed Harvard exchange professor to France and will lecture at the Sorbonne during the second half of the present academic year.

Professor William Alanson Bryan, formerly curator in the Bishop Museum and professor of zoology and geology in the University of Hawaii, has been appointed director of the Los Angeles Science Museum of History, and Art, where he succeeds the late Frank Dagget.

Dr. F. C. Harrison, principal of Macdonald College, was elected as president of the Society of American Bacteriologists, at their annual meeting held at Chicago.

At the annual meeting of the Royal Meteorological Society the following were elected officers: *President,* R. H. Hooker. *Vice-presidents,* J. Baxendell, W. W. Bryant, Sir Napier Shaw and Dr. E. M. Wedderburn. *Treasurer,* W. V. Graham. *Secretaries,* J. S. Dines, L. F. Richardson and G. Thomson.

During the current year the University of Texas established two lectureships to be filled by distinguished scholars from other universities. Professor E. G. Conklin, of Princeton University, was invited to Texas to fill the first engagement. During the week beginning February 28 Dr. Conklin gave a series of five

lectures, two to the general public and three seminar lectures to advanced students in the biological departments. Professor Conklin will also lecture at Houston, Galveston and San Antonio.

ON the evening of February 22, Professor F. R. Watson, of the University of Illinois, delivered an illustrated lecture on "Acoustics of auditoriums" before the Illinois Society of Architects at the Chicago Art Museum.

FREDERICK G. CLAPP, of New York City, an authority on petroleum geology, is giving a series of twelve lectures on that subject at Harvard University, beginning on Tuesday, March 8.

DR. HARLOW SHAPLEY, of the Mount Wilson Observatory, gave a series of illustrated lectures in San Francisco and Berkeley, February 25 and 27, on the following subjects: "New stars and variable stars," Astronomical Society of the Pacific, Native Sons' Hall, San Francisco; "On the structure of the galactic system," astronomical department of the University of California; "The dimensions of the sidereal universe," California Academy of Sciences, Golden Gate Park, San Francisco.

THE joint spring meeting of the Association of American Geographers and the American Geographical Society will be held in New York City on April 22 and 23. The complete program for the meeting will be published in the near future.

THE third annual meeting of the American Society of Mammalogists will be held in Washington, D. C., from May 2 to 4. Sessions devoted to the reading of papers, discussion and business, will be held from 10 A.M. to 4.30 P.M., each day, in the New National Museum. A session may also be arranged for the evening of May 2. Opportunities will be offered to visit various places of zoological interest in the city, and the usual social functions will be arranged.

THE annual meeting of the American Association of Pathologists and Bacteriologists will be held at Cleveland, Ohio, on March 25 and 26. Dr. Howard T. Karsner is the president.

THE next annual meeting of the American Astronomical Society will be held at the Van Vleck Observatory, Wesleyan University, Middletown, Connecticut, from August 30 to September 2, 1921.

THE second annual meeting of the Southwestern Geological Society will be held on March 18, at Tulsa, Oklahoma. The first bulletin of the society will be ready for distribution about that time. The society has a membership of one hundred and seventy-nine. Sections have been organized at Austin, Texas; Houston, Texas; Ardmore, Oklahoma; Okmulgee, Oklahoma; Duncan, Oklahoma; Dallas, Texas, and Shreveport, Louisiana. Visiting geologists in any of these localities are invited to attend the section meetings.

THE Indian Botanical Society has recently been organized with a charter membership of eighty-five. The officers, who serve until the meeting of January, 1922, are as follows: *President,* Winfield Dudgeon; *Vice-president,* W. Burns; *Secretary-treasurer,* Shiv Ram Kashyap; *Councilors,* Birbal Sahni and Rai Bahadur K. Rangachari. The society had its inception in a resolution passed by the Botanical Section of the Indian Science Congress at the Nagpur meeting in January, 1920.

THE Eye-Sight Conservation Council of America with headquarters in New York City, was recently organized, and Mr. L. W. Wallace, New York, was elected president, and Dr. Cassius D. Wescott, Chicago, vice-president. Drs. Frederick R. Green, Chicago; W. S. Rankin, Raleigh, N. C.; Arthur L. Day, Washington, D. C., and Allan J. McLaughlin, U. S. P. H. S., Washington, D. C., are members of the board of councilors. The council has for its object the conservation and improvement of vision by arousing public interest in eye hygiene, especially as it pertains to defective vision and the protection of the eyes in hazardous occupations.

THE trustees of the American Medical Association have made an appropriation to further meritorious research in subjects relating to scientific medicine and of practical interest to the medical profession, which might not be

carried out for lack of funds at hand. Applications for grants should be sent to the Committee on Scientific Research, American Medical Association, 535 North Dearborn Street, Chicago, before April 1, 1921, when action will be taken on the applications at hand.

Dr. J. Paul Goode (Minnesota, '89), of the department of geography of the University of Chicago, gave an address on "Coal and civilization" at the annual banquet of the General Alumni Association at the University of Minnestota, on February 18. The occasion was the fifty-third anniversary of the founding of the University of Minnesota.

Dr. S. B. Wolbach, associate professor of pathology and bacteriology, Harvard University, will deliver the eighth Harvey Society lecture at the New York Academy of Medicine on Saturday evening, March 12. His subject will be "Typhus fever and rickettsia."

Surgeon-General Ireland has completed plans to have prominent physicians of the country deliver addresses before the General Staff College at Washington. Dr. Joel E. Goldthwait, Boston, and Dr. Thomas W. Salmon, New York, recently went to Washington to speak at the college.

The Washington Section of the American Institute of Mining and Metallurgical Engineers held a supper and meeting at the Interior Department on January 14. Dr. H. Foster Bain, the newly appointed director of the Bureau of Mines, lectured on "Mines and mining in the far east."

On behalf of the subscribers to the Poynting Memorial Fund, the portrait of the late Professor J. H. Poynting by Mr. Bernard Munns has been presented to the University of Birmingham, and Mr. W. Waters Butler has presented the portrait of the late Professor Adrian Brown by the same artist.

Dr. William Miller Welch, an authority on contagious diseases, and for more than fifty years connected with the Philadelphia Bureau of Health, and professor in the graduate school of medicine of the University of Pennsylvania, has died at the age of eighty-three years.

Dr. F. J. V. Skiff, director of the Field Museum, Chicago, died on February 24 at the age of sixty-nine years.

The North Carolina Department of Agriculture announces the death of Dr. James Marion Pickel, for many years past the feed chemist of the department.

Dr. J. C. Cain, editor of the publications of the London Chemical Society and author of works on synthetic dyestuffs, died on January 31 at the age of fifty years.

Alfred Gabriel Nathorst, the eminent Swedish geologist and paleobotanist, died at Stockholm on January 20, in his seventy-first year.

Professor T. Miyake, of the department of zoology of the Agricultural College of the Imperial University of Tokyo, died on February 2 of typhoid fever which at that time was prevalent in Tokyo. Professor Miyake will be remembered as the author of a large two-volume work on the entomology of Japan, a review of which was published in Science some months ago.

The request is made to botanists to supply the department of botany of the Alabama Polytechnic Institute with separates and other publications to help restore the library which was lost in the fire which destroyed the agricultural building.

The sum of $500,000 has been given by Dr. Frank Schamberg, Dr. John A. Kolmer and Professor George M. Raiziss to the dermatological research laboratories of the University of Pennsylvania for the support of medical research. The sum represents the profits received by the laboratories during the war from the sale of the drug arsphenamine, a solution for German salvarsan. Its manufacture was the result of experiments conducted in the dermatological research laboratories by Dr. Schamberg and his two assistants, Dr. Kolmer, professor of pathology and bacteriology of the graduate school of medicine of the University of Pennsylvania, and George M. Raiziss, professor of chemotherapy at the same school of

the university. Dr. Schamberg was director of the Research Institute.

THE magnetic-survey yacht *Carnegie*, under the command of J. P. Ault, arrived at San Francisco on February 19. After re-outfitting there, she will continue her present circumnavigation cruise, which was begun at Washington in October, 1919, and has an aggregate length of about 62,000 nautical miles. She will cruise in the Pacific Ocean until about September and thence return via the Panama Canal to Washington in October.

PUBLIC lectures under the auspices of the New York City College Chemical Society, in the Doremus Lecture Theatre at four-thirty P.M. are announced as follows:

March 7. "Beyond the laboratory," Ellwood Hendrick.

March 15. "The service of the synthetic dye industry to the state," Marston Taylor Bogert, professor of chemistry at Columbia University.

March 23. "The trail of the chemist in the packing industry," Charles H. MacDowell, president, Armour Chemical Company.

April 8. "Explosives in war and peace," Ernest M. Symmes, Hercules Powder Co.

April 14. "Chemical evolution," Daniel D. Jackson, professor of chemical engineering at Columbia University.

THE Southwestern Division of the American Association for the Advancement of Science announces the following lectures at El Paso:

February 15. "How to live," Dr. Jenness.

March 1. "Alien insect enemies," Benjamin Druckermaur.

March 14. "The mechanism of heredity, development and evolution," Edwin Grant Conklin, of Princeton University.

March 15. "Historical progress in chemical theory," F. H. Seamon.

April 5. "Reclamation work," L. M. Lawson.

April 19. "Great American scientists: Major J. W. Powell and Professor Langley," E. C. Prentiss.

May 3. "Southwestern agricultural problems," Robert S. Trumbull.

May —. "Archæology," Edgar L. Hewett, of the School of American Research, Santa Fe, N. M.

May 17. "Crystallography," James C. Crichett.

UNIVERSITY AND EDUCATIONAL NEWS

BY the will of Miss Helen F. Massey a legacy of $500,000 has been left to the University of Pennsylvania. It is reported that one of the conditions of the bequest is that the income shall be used for increasing the salaries of members of the college faculty.

HAROLD HIBBERT, Ph.D., Sc.D., assistant professor in Yale University, has been promoted to an associate professorship of applied chemistry, and assigned to the graduate school and the Sheffield Scientific School.

DR. HUGH C. MULDOON, professor of chemistry at the Albany College of Pharmacy, has become dean and professor of chemistry in the School of Pharmacy, Valparaiso University.

THE biology department, Macdonald College, has been divided into two departments, the department of entomology and zoology, under Professor William Lochhead, and the department of botany, under Professor B. T. Dickson. Dr. G. P. McRostie, Ph.D. (Cornell, '17), has been appointed assistant professor in the cereal husbandry department in charge of grass and clover investigations, and Walter Biffen, B.Sc. (Wales '06), has been appointed lecturer in the department of botany.

DISCUSSION AND CORRESPONDENCE

MUSICAL NOTATION

TO THE EDITOR OF SCIENCE: While musical notation is not a matter of great scientific interest, reform presumably is.

The desirability of the changes advocated by Professors Huntington and Hall may be admitted. This leaves the space available for briefly discussing the cost.

The reform of printing implies (1) reprinting all existing music, and (2) scrapping some machinery, type, etc.

There is also an ideal cost. Whatever the exact methods of physical science may ultimately reveal as to the pitch in orchestral

playing, there is no question for instance that a succession of notes, G, G sharp, A and a succession G, A flat, A, are musically distinct, and that each actual sound on the piano is a symbol used to stand in turn for many musical entities. The reformed method would destroy the signs of some of these distinctions and reduce playing at sight to striking a succession of notes with little chance of prevision of the musical meaning.

As to the reformed keyboard there is again an obvious material if no clear ideal loss. However the judgment that the simplification of "physiological reflex" is of much value might be demurred to. One can conceive a psychologist taking the stand that a reflex is a reflex, and a musician saying that he had established the reflexes and forgotten the process. Finally we might have a violinist objecting to the pianist borrowing his G clef and returning it in a damaged condition, for advantages on the keyboard would be disadvantages on the fingerboard where the hand covers an octave diatonically and the accidentals are made by a special finger movement.

If musicians should bring forward these matters it must not be inferred that they are opposed to reform. On the contrary most of them desire it but can not meet the bill. The piano is no worse off than other instruments, probably better. A tenor trombone player in the ordinary week's work may have to read from music written in six or seven different systems, but the world rarely hears his complaints.

R. P. Baker

Iowa City, Iowa

MIRAGE AT SEA

To the Editor of Science: In the Sections reports of the meeting of the B. A. A. S., Bristol, 1875, p. 26, M. J. Janssen gave a brief summary of his observations and conclusions with regard to mirage at sea. As this happens to connect with a phase of low sun phenomena in which I am interested, and as I find no trace of any further publication by him, I would be glad to receive information as to whether he published further on this subject.

Willard J. Fisher

Woods Hole, Mass.

THE SIDEWALK MIRAGE

To the Editor of Science: My first experience with the sidewalk mirage described by Professor McNair in your issue of August 27, was on a smoothly paved straight-away between Canton and Alliance, Ohio. The time was three o'clock p.m. of a very hot day in August, 1918, the temperature being just about 100°. We were headed east on a level stretch, while about a mile ahead of us on a slightly higher level was a car apparently submerged in water to a depth of about two feet. A woman crossing the roadway was "in" up over her knees. As none of our party had ever seen such a reflection we got out of the car lest it might be caused by the windshield. At first the vision was lost until we discovered that the angle of vision was so small that we had to hunt for it, when it remained clear and distinct as long as we had the time to watch it.

Since that time I have seen a number of similar reflections, some in warm weather and others in cold; which leads me to conclude that heat is not necessary to produce them. The distance appears to govern the height from the ground as I have seen one within a distance of a square and it was within two or three inches of the surface. The surface reflection mentioned by Mr. Platt in your issue of September 27 is not uncommon, but could never be mistaken for the mirror-like surface of the mirage after you have seen a real one. Such explanations as I worked out in 1918 were upset the following winter and I shall watch with interest for further information that may be offered.

C. P. Du Shane

A RAINBOW AT NIGHT

To the Editor of Science: About 11 p.m. on Thursday, November 18, while waiting for a street car, I saw a clearly defined rainbow—a phenomenon which is possibly of sufficiently rare occurrence at night to be of interest to some of your readers.

A drizzling rain was falling overhead, but

stars were shining brightly to the north. The moon, which was very low in the west (about 15° south of west, with an altitude of some 5° or 6°), was hidden from view by buildings, where I stood; and, because of the street lights, I was not even aware that the moon was out until the rainbow in the east caught my eye. None of the prismatic colors could be detected, the bow being merely a yellowish arch of light very well defined at the southern end—rather an odd thing to see at that time of night.

FRANK L. GRIFFIN

REED COLLEGE,
PORTLAND, ORE.

SCIENTIFIC BOOKS

Gli Scienziati Italiani, dall'inizio del medio evo ai nostri giorni. Repertorio biobibliografico dei filosofii, matematici, astronomi, fisici, chimici, naturalisti, medici, e geografi Italiani. Diretto da ALDO MIELI, e compiuto con la collaborazione di numerosi scienziati, storici, e bibliografi. Vol. I., Parte I., Rome, 1921. Pp. viii + 236. A. Nardecchia, publisher.

In the issue of SCIENCE of August 30, 1919, pp. 213–214, I called attention to Italian activity in the field of the history of science, evidenced by the new publication *Archivio di Storia della Scienza,* edited by Aldo Mieli, which journal has now completed its first year. The present work indicates the continued and growing interest in Italy in the history of science.

The first part of this biographical dictionary presents the biographies of thirty-three Italian scientists from the fifteenth to the present century. The list of contributors to the volume shows that the great scholars of Italy are devoting themselves to assure the success of the present work under the able editorship of the distinguished historian of science, Aldo Mieli.

One peculiarity of the work is that neither chronological nor alphabetical order of treatment is pursued in selecting the scientists included. Eventually, of course, the completed work will be provided with all necessary indices. Each volume includes also the alphabetical index of names.

The order of treatment of each biography consists of the following: Life; Works, including a critical discussion of the historical and scientific significance; Bibliography, including complete catalogue of all works, with place and date of printing of published works, editions, and translations with precise bibliographical descriptions and also some statement of location in Italian libraries of volumes mentioned; Literature, giving lists of works which discuss the work or life of the scientist in question.

The mathematician will welcome the fine biographical statement (pp. 4–12) concerning Leonardo Fibonacci, written by Gino Loria; the astronomer will appreciate the excellent account (pp. 45–67) of Schiaparelli, by Elia Millosevich; the geographer and the astronomer will find much of interest in the account (pp. 101–111) of Giovanni Antonio Magini (1555–1617) by Antonio Favaro, who lists no less than 47 printed works (and editions) by Magini; the student of medical history, the botanist and naturalist and the physicist will enjoy a whole series of illuminating articles. Particularly noteworthy is the fact that a photograph and a facsimile of handwriting is given of each scientist, wherever possible.

This publication promises to be a work comparable only to the English Dictionary of National Biography; for America, France or Germany there is no work of this nature. When completed on present plans libraries will find it as indispensable as the above mentioned dictionary.

With the present state of exchange the price of 45 liras for Part I., viii plus 236 pages, is extremely low. Every effort should be made by American scientists, historians, and librarians to encourage the continuation of this publication on the present scale. The effective way to do this is by subscription to the publisher, A. Nardecchia, Via dell' Universita 11–14, Rome, Italy.

The alphabetical list of articles follows:

Acri, Francesco (1834–1913), philosopher, by E. P. Lamanna.

Alpino, Prospero (1553–1616) botanist, by A. Beguinot.

Amici, Giovanni Battista (1786–1863) physicist. naturalist, by G. B. De Toni.

Anguillara, Luigi (c. 1512–1570) botanist, by G. B. De Toni.

Baranzano, Redento (1590–1622) philosopher, astronomer, by G. Boffito.

Bertini, Anton Francesco (1658–1726), physician, by A. Corsini.

Bertini, Giuseppe (1772–1845) physician, by A. Corsini.

Bertini, Giuseppe Maria Saverio (1694–1756), physician, by A. Corsini.

Biringuccio, Vannoccio (1480–1530?), technician, chemist, by A. Mieli.

Cestoni, Diacinto (1637–1718), naturalist, by G. Stefanini.

Chiarugi, Vincenzo (1759–1820) psychiatrist, physician, by A. Vedrani.

Cocchi, Antonio (1695–1758), physician, by A. Corsini.

Corti, Bonaventura (1729–1813), botanist, by G. B. De Toni.

Cotugno, Domenico (1736–1822), physician, by G. Bilancioni.

De Visiani, Roberto (1800–1878), botanist, by A. Beguinot.

Dini, Ulisse (1845–1918), mathematician, by G. Loria.

Fibonacci, Leonardo (sec. xii–xiii), mathematician, by G. Loria.

Figari, Antonio (1804–1870) traveler, naturalist, by G. Stefanini.

Folli, Francesco (1624–1685), physician, naturalist, by G. Goretti-Miniati.

Ghini, Luca (c. 1490–1556), botanist, by G. B. De Toni.

Guilandino, Melchiorre (c. 1520–1589), botanist, by G. B. De Toni.

Inghirami, Giovanni (1779–1851), astronomer, by G. Giovannozzi.

Magini, Giovanni Antonio (1555-1617), astronomer, geographer, by A. Favaro.

Maranta, Bartolomeo (c. 1500–1511), physician, botanist, by G. B. De Toni.

Moletti, Giuseppe (1531–1588) astronomer, cosmographer, by A. Favaro.

Passerini, Giovanni (1816–1893), botanist, by G. B. De Toni.

Piccone, Antonio (1844–1901), botanist, by G. B. De Toni.

Pontedera, Giulio (1688–1737), botanist, by A. Beguinot.

Riva, Giovanni Guglielmo, (1627–1677), physician, by C. Artom.

Schiaparelli, Giovanni Virginio (1835–1910) astronomer, historian of science, by E. Millosevich.

Silvestri, Francesco (1474–1528), philosopher, by G. Sestili.

Sterzi, Giuseppe (1876–1919), anatomist, by G. Favaro.

Valli, Eusebio (1755–1816), physician, by A. Vedrani.

Zanardini, Giovanni (1804–1878), physician, botanist, by G. B. De Toni.

Louis C. Karpinski
University of Michigan

SPECIAL ARTICLES

THE EINSTEIN SOLAR FIELD AND SPACE OF SIX DIMENSIONS

The Einstein theory is four-dimensional in the sense that four (general or world) coordinates x_1, x_2, x_3, x_4 are employed. The fundamental quadratic form

$$ds^2 = \Sigma g_{ik} dx_i dx_k,$$

where the ten potentials g_{ik} are functions of the four coordinates, in general has a curvature tensor which does not vanish, and therefore defines a curved manifold M of four dimensions. In fact M is flat or euclidean or homodoidal only when there is no actual gravitation. Excluding this trivial case, the question arises what is the flat space of fewest dimensions n, which can be regarded as containing the curved manifold M?

Abstractly considered the possible values of n are 5, 6, 7, 8, 9, 10; that is, any M can surely be immersed in a flat space of not more than 10 dimensions. But if we take into account Einstein's differential equations of gravitation, $R_{ik} = 0$, or $G_{ik} = 0$, we find that the simplest case, $n = 5$, is actually impossible. That is to say:

An Einstein four-dimensional manifold, defining a permanent gravitational field, can never be regarded as immersed in a flat space of five dimensions.

This applies in particular to the solar field (defined say by the Schwarzschild form), in which the earth and the other planets are moving. The appropriate value of n must therefore be greater than 5 and less than 11. A brief discussion shows that actually $n = 6$. Therefore:

The solar gravitational field can be represented by a curved manifold of four dimensions situated in a flat space of six dimensions.

This manifold can be written in finite form and gives what may be called a *geometric model* of the field in which we are living.

The proofs of these theorems and the actual equation of this model are appearing in current numbers of the *American Journal of Mathematics,* together with the full discussion of the general results connecting light rays and orbits in any field stated in Science, October 29, 1920, pp. 413–414.

Edward Kasner
Columbia University

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

FERTILIZER DIVISION

F. B. Carpenter, *chairman*
H. C. Moore, *secretary*

Kelp as a basis of an American potash industry: J. W. Turrentine.

Relationships of chemistry and the fertilizer industry: C. H. MacDowell.

A perfect fertilizer law: E. G. Proulx.

Boron in relation to the fertilizer industry: J. E. Breckenridge.

The quantitative estimation of borax in mixed fertilizers: J. M. Bartlett.

Note on the determination of nitrogen in fertilizers containing both organic and nitric nitrogen: F. B. Carpenter. Notwithstanding the fact that the modified Kjeldahl and Gunning methods have been in use for a number of years, the results obtained by these methods in the hands of different analysts on samples containing mixtures of organic and nitric nitrogen are far from satisfactory. This is probably largely due to a wrong interpretation of the official method. From the standpoint of the manufacturer this is quite a serious matter and it seems desirable that the Association of Official Agricultural Chemists should take such action as is necessary to modify or at least change the reading of the modified methods so that there may be no misunderstanding of how they should be carried out.

Dicyanodiamide. A rapid, direct method for its determination in cyanamid and mixed fertilizers: Rolla N. Harger, presented by Oswald Schreiner. The method depends upon the fact that when a solution of silver picrate is added to a solution of dicyanodiamide, the latter is quantitatively precipitated as a double compound of silver picrate and dicyanodiamide, $C_6H_2(NO_2)_3OAG$, $C_2H_4N_4$. This new double compound we have named silver picrate-mono-cyanoguanidine. It forms in small crystals which quickly settle out of the solution and can be separated upon a Gooch crucible very rapidly, so that the analysis can be carried out in a very short time. Neither cyanide nor urea give any precipitate when their solutions are treated with silver picrate, and determinations of dicyanodiamide carried out in the presence of these compounds showed that they have no effect upon the analysis. The molar weight of the compound is 420.22, five (4.991) times that of dicyanodiamide, a fact which greatly enhances the accuracy of the method, since an error of 1 mg. in the precipitate weighed will mean an error of only 0.2 mg. of dicyanodiamide or 0.13 + mg. of nitrogen.

The changes taking place in cyanamid when used in mixed fertilizers: Rolla N. Harger, presented by Oswald Schreiner. (1) When cyanamid is placed in a mixed fertilizer containing acid phosphate and 5–10 per cent. of moisture, the cyanamide content decreases with great rapidity. (2) This change is represented principally by, and in many cases quantitatively by, the formation of dicyanodiamide. (3) A given quantity of moist acid phosphate is able to transform a limited amount of calcium cyanamid. (4) Cyanamid is not affected by dry acid phosphate. (5) Moisture alone is able to cause the conversion of cyanamid to dicyanodiamid, but the change is much slower than when acid phosphate is present. Since it has been repeatedly shown that dicyanodiamid is valueless as a fertilizer material and, moreover, is toxic to many plants, the formation of this compound in fertilizer materials seems undesirable. From the results of this study it would seem that

the method of applying cyanamid, commonly employed, which consists in adding the cyanamid to fertilizer mixtures containing acid phosphate, which mixtures almost always contain several per cent. of moisture, is a very questionable practise. Moreover, the use of cyanamid as a "conditioner" for "green" acid phosphate is very probably at the expense of most of the nitrogen in the cyanamid. On first thought it would appear that this conversion of cyanamid into dicyanodiamide could be avoided by simply employing dry fertilizer mixtures, but this overlooks the fact that when such mixtures are added to the soil moisture conditions are at once provided and the transformation may possibly then take place. Preliminary experiments carried out in this laboratory indicate that under certain conditions at least this is the case.

Some results of the determination of potash by the Lindo-Gladding method, using alcohol of various strengths in the presence of sodium salts: R. D. Caldwell and H. C. Moore. When potash is determined by the official method of the A. O. A. C. but slightly lower results are obtained when 80 per cent. alcohol is used than when 92 or 95 per cent. is used in case of sample of pure potassium chloride, but when sodium chloride or sulfate is added the results with 80 per cent. alcohol are lower. Tests with a sample of potassium platinic chloride showed it to be but slightly soluble in 80 per cent. alcohol alone, but the solubility increases with the increase of sodium salts added but with 95 per cent. alcohol sodium salts have no effect.

Injurious effects of borax on field crops: F. B. Carpenter. It has long been known that certain chemical substances are poisonous to plant life. While certain compounds of copper, zinc and arsenic are exceedingly poisonous, compounds of manganese and boron are far less deleterious. Most of the experiments which have been made with these compounds have been made on plants grown in pots or water cultures; in case of borax, however, considerable knowledge has been gained during the past few years on field crops from the use of Searles Lake potash, which contained an excessive amount of this compound. The first large scale borax poisoning in this country occurred in Indiana in 1917 on corn. In 1919 considerable damage was reported on potatoes and tobacco in different localities. Many conflicting reports were made in regard to amount of borax required to produce injury. While in some instances as little as two pounds per acre has been reported to have slightly injurious effects, one report was noted where as much as 400 pounds per acre was used with apparently no bad results. Experiments made by the writer on corn, beans, cotton, Irish potatoes, sweet potatoes and tobacco showed no bad effects where 8 pounds anhydrous borax per acre were used, but there was slight injury with sixteen pounds. It is evident, therefore, that the character of soil, amount and time of rainfall, the manner of application, etc., influence to a large degree the amount of borax which can be used without poisonous effect.

The "blank" in the Kjeldahl process; its analytical and commercial significance: B. F. Robertson.

Potash shales of Illinois: M. M. Austin and S. W. Parr. (1) Shales occur in at least two localities in Illinois which contain five per cent. or more of potash. (2) Shale outcropping in several places near Jonesboro in Union County which contain five per cent. of potash would be suitable, so far as can be determined from its chemical composition and physical character, for use in the manufacture of Portland cement. (3) By using this material in the manufacture of cement and by applying the known methods of potash recovery, a yield of 5.3 pounds of potash, representing a value of 70 to 80 cents per barrel of cement could be obtained. (4) The constitution of the southern Illinois shale is complex. The shale contains free oil, bituminous matter, pyrite, undecomposed potassium bearing rock, feldspathic in character and potassium bearing material of the nature of glauconite or greensand. (5) Shale from Dixon, Lee County, contains 5.8 per cent. of potash which is held for the most part in a more stable condition than that in the southern Illinois shale. (6) Extraction of the potassium from shale of either the southern Illinois or Dixon type by means of solid or liquid reagents would seem to be impracticable, because of the incomplete reaction of these reagents on the shale and because of the cost of leaching and recovering potash from material where it is present in such small amounts. (7) The plant availability of the potash in the southern Illinois shale is probably characteristic of all of the material of this type outcropping in that locality. (8) That part of the potassium in the southern Illinois shale which is soluble in sulphuric acid, is shown to be in a combination of the glauconite type. (9) In southern Illinois shale having a potash content of 5.0 per cent. in the raw condition or 5.6 per cent. when ignited, 62 per cent. of the total potash is glauconitic in character and is available as plant food.

Potash situation in Germany: H. A. Huston.

RUBBER DIVISION

W. K. Lewis, *chairman*

Arnold H. Smith, *secretary*

Reports.

Discussion: Shall the Rubber Division publish an annual volume of reprints and lengthy abstracts of everything of interest to the rubber chemist made public during the year?

Election of officers.

Rubber energy: W. B. WIEGAND. (Lantern.)

The aging of some rubber compounds: New Jersey Zinc Co. Research Laboratories. (Lantern.)

Some microsections cut from vulcanized rubber articles: New Jersey Zinc Co. Research Laboratories. (Lantern.)

The action of certain organic accelerators in the vulcanization of rubber. II.: G. D. KRATZ, A. H. FLOWER and B. J. SHAPIRO. The relative activities of molecularly equivalent amounts of aniline and diphenylthiourea in the acceleration of vulcanization were compared in rubber-sulfur mixtures and in mixtures which contained zinc oxide. In a rubber-sulfur mixture the activity of aniline was found to be much greater than that of diphenylthiourea. In mixtures which contained zinc oxide, the reverse was true. With aniline as the accelerator, either in the presence or absence of zinc oxide, the same maximum tensile strength was obtained, accompanied by a higher sulfur coefficient in the absence of zinc oxide than when this substance was present. The mixtures which contained zinc oxide, attained the same maximum tensile strengths at approximately the same sulfur coefficients, irrespective of whether aniline or diphenylthiourea was employed as the accelerator. It is evident that there is apparently no general relation between the physical properties and sulfur coefficients of accelerated mixtures.

The action of certain organic accelerators in the vulcanization of rubber. (II.): G. D. KRATZ, A. H. FLOWER and B. J. SHAPIRO. The activities of certain synthetic, nitrogenous organic accelerators, in a mixture of rubber and sulfur, were compared with the dissociation constants of the original substances. With the exception of members of a closely related series, no definite relation was found to exist between the activities of the substances as accelerators and their dissociation constants. Substances which decompose, or react, with other components of the mixture to form substances of acid character do not accelerate unless a neutralizing base, or salt, is present. The results obtained, and the conclusions drawn from them, compare favorably with other results obtained with ammonium salts.

Method for the determination of free sulfur and antimony tri- and penta-sulfides in golden antimony: J. F. SCHUFTER.

The action of heat and light on vulcanized rubber: J. B. TUTTLE. The action of heat and light on vulcanized rubber is frequently spoken of as being identical and oxidation is said to be the cause of the deterioration. From published and unpublished tests it is shown that the action of heat is one of change in the rate of the chemical reaction between rubber and sulfur and goes on throughout the entire mass, whereas the action of light is one of oxidation, taking place on the surface. Heat produces no change in the solubility of the rubber substance in solvents such as acetone and alcohol, whereas light breaks up the rubber molecule forming decomposition products which are readily soluble in acetone.

A theory of vulcanization based on the formation of polysulphides during vulcanization: WINFIELD SCOTT and C. W. BEDFORD. All organic accelerators and a number of inorganic accelerators function as catalysts of vulcanization through the formation of polysulphides. These accelerators may be placed into two classes: (1) Hydrogen sulphide polysulphide accelerators. Organic bases are believed to form polysulphides by the aid of hydrogen sulphide. Examples are piperidene and dimethylamine which form polysulphides in the presence of hydrogen sulphide and sulphur. Inorganic bases, such as sodium hydroxide, calcium hydrate, magnesium oxide and basic magnesium carbonate, function in the same manner as the above. (2) Carbo-sulph-hydrol polysulphide accelerators. Thio ureas and dithiocarbamates are believed to form some type of polysulphides through the grouping C-SH. Differentiated from the above two classes of accelerators are such accelerators as zinc oxide and litharge which do not form polysulphides. These are termed "secondary accelerators" owing to the fact that they decompose polysulphides to give active sulphur.

DIVISION OF WATER, SEWAGE AND SANITATION

J. W. Ellms, *chairman*

W. W. Skinner, *secretary*

Water softening for the manufacture of raw water ice: A. S. BEHRMAN. The manufacture of

ice from distilled water is rapidly being replaced by production of ice from raw water, due principally to cheap dependable power and water softening. The requisite characteristics of first quality ice are clearness, firmness and freedom from discoloration. In freezing water, by far the greatest part of the substances dissolved in it freeze out in the ice produced. Ice made from impure water is opaque, discolored and brittle, depending on the nature of the impurities. Lime-soda softening, followed by sand filtration, is the most efficient purification of raw water to be frozen. The most objectionable impurities are compounds of magnesium, calcium and iron, organic matter, silica and alumina, and sodium salts. Softening with lime eliminates temporary hardness, magnesium and iron, and reduces organic matter, silica and alumina. Recent investigations indicate that soda may be omitted from treatment, as removal of permanent hardness appears to be unimportant if all of magnesium is replaced by calcium. Temporary hardness is particularly objectionable, causing gritty white sediments in center of cake, white deposits in clear ice, weak structure, and probably crackings and also necessitates one or more core pumpings. Zeolite softening of the raw water has been shown to be unsuitable for ice making, due to the relatively large quantity of sodium salts which it leaves in the treated water to retard freezing and form deposits, to the fact that bicarbonates, which are in some manner connected with cracking, are not removed, and to the non-removal of iron, organic matter, alumina and silica.

Specifications for glassware for waterworks laboratories: Harry E. Jordan.

Hardness of surface waters in the United States: W. D. Collins.

The new sewage testing station of the Illinois State Water Survey Division: Edward Bartow. With the cooperation and assistance of the Sanitary Districts in Illinois, The State Water Survey Division has started again the sewage testing station that was operated from 1914–17 and in which work was practically discontinued during the war. It is proposed to test all processes of sewage disposal that may be applicable to Illinois conditions, as time and funds permit. The first test will be of the Dorr-Peck modification of the activated sludge process, which will be tested from raw sewage to clarified effluent and to dried sludge.

Charles L. Parsons,
Secretary

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

Section E of the American Association for the Advancement of Science held its sessions this year in conjunction with the Geological Society of America and the Association of American Geographers, in Rosenwald Hall of the University of Chicago, from December 28 to January 1. In accordance with the agreement whereby the affiliated societies take charge of the program whenever they meet jointly with Section E, the Section had no program of its own. The address of the retiring vice-president, Dr. Charles Kenneth Leith, of the University of Wisconsin, upon the subject, "The structural failure of the lithosphere," was delivered on the evening of December 28 at the annual smoker of the Geological Society of America. It has been published in Science. The papers of the general sessions will appear in the *Bulletin of the Geological Society of America,* Vol. 32, and in the *Annals of the Association of American Geographers,* Vol. 11.

At the regular meeting of the Sectional Committee the following were nominated for sectional officers:

Vice-president and Chairman of the Section, Dr. Willet G. Miller, director of the Ontario Bureau of Mines.

Secretary for 4 Years, Dr. Elwood S. Moore, Pennsylvania State College.

The election of a committee member was not required this year.

Rollin T. Chamberlin,
Secretary

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MEDICINE AND THE PUBLIC[1]

Mr. President, Members of the Medical Society, Ladies and Gentlemen: We are gathered here to-night to dedicate this building to the science of medicine in the District of Columbia, and, in a broader sense, to the service of the community and humanity.

This beautiful building is the realization of the dream of the society for a century and over, and has been made possible by the loyalty and self-sacrifice of a large majority of the medical men of this city, and the generosity of many friends of our profession here and elsewhere.

The funds necessary for the erection of this building were raised in two years by the persistent, untiring efforts of the members of the building committee, who have had supervision of the preparation and execution of the plans, and who feel that they can congratulate the architect, the contractor, the Medical Society and the District of Columbia upon the results.

While the funds immediately necessary for the erection of the building have been raised, there remains a mortgage of fifty thousand dollars to be carried by the society.

It is the desire of a majority of the members that this indebtedness be paid off in the near future in order that this building may be presented to posterity as their contribution, leaving the care and maintenance as the only burden.

The aim of the Medical Society as typified in this building is the elevation of the profession to a higher scientific standard for increased public usefulness. There can be no doubt that this aim concerns the public even more than it does the profession. The more highly developed the scientific attainments of the medical profession, the more it redounds

[1] Dedicatory address delivered on occasion of the opening of the new home of the Medical Society of the District of Columbia, January 12, 1921.

to the advantage of the public, which receives thereby increasingly efficient service from the individual members of the profession. It is in this way that the interests of the profession and the laity are interwoven.

Feeling, as we do, that the influence of our profession in public affairs just at the present time is not so potent as it was a generation ago, or as it should be, we have cast about to discover the cause and, following the traditions of our profession, to apply the appropriate remedy for the malady. After oft-repeated discussions the general feeling has come to prevail that the lack of professional solidarity is the underlying cause which robs us of the influence at the council table of our city which unselfish devotion to the best interests of the public appears to justify.

Recognizing the gravity of this condition, our former president, Dr. Davidson, conceived the cure, in leading the society to undertake the erection of a commodious centrally located home of its own. To him the members of the society are indebted for this beautiful edifice and his name will go down in the history of the society, and of this city, as one of the great benefactors of his time.

The beneficial effects are already evidenced in the enthusiastic loyal cooperation of the members of the society and of its lay friends who have made possible the completion of the task, rendered more difficult by the disturbed conditions which prevailed in this city and throughout the length and breadth of the land.

No profession has loftier traditions and aims than have animated the medical profession throughout all the ages. In the past the medical profession has been interested in all the great questions of the day, whether pertaining to the health of the community or matters entirely outside of the realm of medicine.

Let us not be satisfied with the accomplishment of scientific attainments, but ever keep in mind our broader duties as citizens of this great republic.

In fulfilling our duty to the public let us not be unmindful of our sacred obligations to the fellows of our own profession, especially those who through misfortune need our aid, sympathy and encouragement. In this connection may we not do well to borrow from the little people across the Pacific the motto which is symbolized in those two little bronzes seen upon the Temple of Nikko, which warn the traveller to "see no evil, hear no evil, speak no evil." In the consideration of our broader duties as true physicians, let us lend our earnest aid not only to those in whose keeping the moral and spiritual welfare of the community rests, but to give in our daily work such council and encouragement along these lines as lie within our power.

In turning to a consideration of what the Medical Society of the District of Columbia has accomplished for our city we find achievements of which we may be justly proud. The curbing of typhoid by securing an abundant supply of pure water and pure milk; the medical inspection of the school, by which nutritional diseases, defective eyesight and infectious fevers are reduced to a minimum; providing for new hospitals, raising the standards of the older institutions; the practical elimination of malaria through the reclamation of the Potomac flats, which were the breeding places of the mosquito; the effective control of contagious and infectious fevers through compelling quarantine, with report of such cases to the Health Department; the inauguration of the crusade against tuberculosis and the bringing the knowledge of its communicability and the care of the disease to the attention of the public; the compulsory registration of births and deaths and many other questions pertaining to the welfare of the public have been enthusiastically supported by one Medical Society.

What I have said will convince you that the best individual and collective efforts of our profession as represented by the Medical Society of the District of Columbia have been and are being spent in the service of the community and of our country.

Perhaps in none of the professions does the student by his mere entry accept such a burden of responsibility; and, if achievement is measured by opportunity, in no other profession is he so certain—whatever his accom-

plishments—to fall far below the ideal set for him by the traditions and history of his calling.

From the days of St. Luke to this very evening, the profession has recognized its duty and responsibility and in the fullest sense has endeavored to meet them. As steadily and quietly as water flows, and with the same beneficent effect upon mankind, the work of the medical man has proceeded through all the ages covered by recorded history.

At first, service rendered by his own hands to the sufferer—combining the functions of physician, surgeon, nurse and pharmacist; then, with the development of knowledge, a separation of these fields of work; then a cultivation and intensification of the possibilities in each field; but always service.

Always the subordination of his own comfort; of opportunities for wealth; of leisure; of home life; of public recognition; to the need of serving mankind; and, in instances without number, the sacrifice of life itself in the effort to serve his fellow man; to extend and broaden knowledge, and thereby acquire the means whereby others might live.

No man dare think or say these things of himself; but if they are to be seen in others, if they form a part of the noble traditions of a profession to which he has been called; if they are of the very character and being of his brothers in that profession, then he may recognize and proclaim them, for they are not only his, they are a portion of the heritage of all mankind.

The members of this Society permitted no object of personal ambition and no activity of professional life to withhold from our government during its hours of stress the devotion and service due from each citizen. This was proven by the ready response to the government's call for physicians during the recent World War, when more than one fourth of the total number of our doctors enlisted in one or another of the three branches of the service. Of this number three made the supreme sacrifice in giving their lives for their country.

During the campaign for obtaining funds for the erection of this building it was interesting and gratifying to note that when the public became acquainted with the aims and accomplishments of our medical society, it responded promptly and generously to our appeal for financial assistance, and I repeat, that this appeal was not wholly, nor indeed in greater part, for the ultimate benefit of the medical society, for, as I have already shown, the interest of the community and the society are identical.

Through the influence of this building the standard of medical practise will be elevated. This will come about by additional facilities for scientific research, by lectures with their stimulating discussions, as well as by the presentation of unusual cases and rare specimens.

The Medical Society of the District of Columbia has the standing of a state society and as such is an integral part of the American Medical Association. One of the nine trustees of the American Medical Association who controls the finances and policies of that great organization composed of more than sixty thousand men of the medical profession, is a member of our society. The society also has its representative in the House of Delegates of the American Medical Association. It may not be inappropriate to mention in this connection that we are the only state society to hold weekly meetings throughout the year, which in itself increases immeasurably its sphere of teaching.

The Medical Society of the District of Columbia was founded September twenty-forth, eighteen hundred and seventeen, and during the one hundred and three years which have elapsed since that time the science of modern medicine has been developed. The society numbers among its members past and present physicians who have made valuable contributions to the development of medical science.

The membership body of the Medical Society of the District of Columbia comprises every branch of medical science and every age of medical man from the recent graduate to those who through long years of service

have earned retirement. The society especially fosters and encourages younger members to read essays and to present unusual cases, and they are always certain of an appreciative audience. This is a keen incentive to study and research work.

Since it is true that history repeats itself, is it not well to pause now and then to take a glance at the achievements of the past in order to gain new encouragement for the accomplishment of the future?

A survey of its history shows that medicine has had a far greater development in the past century than in all previous time. The changes that have taken place have been truly stupendous. The current of medical progress is still in rapid and vigorous flow, with no sign of slowing. A multitude of keen investigators are eagerly and industriously hunting out and developing new knowledge and new methods. Every year or two yields new facts of fundamental value. These discoveries are rapidly assimilated into the body of diagnostic and therapeutic methods and practise; the novelty of one year becomes the routine of the next.

Of the great body of science, medicine is an integral part. In no department of knowledge is scientific method more rigorously pursued, or with more productive results than in medicine. It is the use of the scientific method alone that has brought about the vast development of medicine within the past century, with all the resultant benefit to mankind. In no field of human activity is there a greater exercise of humanitarian spirit than in medicine. In the difficulties that confront mankind to-day, the course and the duty of the medical profession are clear—to continue the vigorous employment of those scientific principles and the exercise of the altruistic spirit that elevated medicine out of the empirical and stagnant inefficiency that characterized it for a thousand years. Furthermore, medicine is in a position to offer the application of those same principles and spirit to the solution of the grave difficulties that confront mankind to-day. Medicine can proudly present its record before the world as a conspicuous example of the attainment of substantial efficiency and social service; the methods and the spirit that have brought success to medicine ought to help in bringing equal efficiency and achievement in industrial, economic and civic institutions.

The great achievement of medicine not only affords us inspiration and pride, but impose upon us serious responsibilities and obligations. It is our duty, individually and collectively, to keep ourselves worthy of our great profession, assiduously to cultivate our art, to maintain unimpaired the great heritage of the past, and, as opportunity offers, to add to the store of medical knowledge. We should cherish the principles and the spirit that have brought us to our proud position. We should keep aglow the light that has dispelled so much of the darkness and obscurity of the peculiar problems that confront us, and let that light shine into the gloom of a disordered world. In the consciousness of the great achievements and usefulness that have been attained, and in our own assiduous efforts to live up to the spirit of our great profession, rest the greatest satisfactions and the greatest rewards that can come to us.

Will you not turn with me for a brief glance at some of the developments in medicine during the last half century. In the short time which I have at my disposal it will be possible to touch only the high lights of this subject.

Fifty years ago the use of the microscope was in the hands of a few men who devoted their lives exclusively to research work, whereas to-day, it is one of the instruments at the right hand of every busy practitioner, who would feel as much at sea without it as without his stethescope or test tube.

Among the broader developments of the last half century when medical science branched out and its progress depended upon highly specialized study and research, the practise of medicine evolved the specialist. These have increased to enormous numbers, and surely for the most part are justifiable, but it must be confessed that some are needless and immature. It will require a decade or more to

drop to the mean level in this regard. There can be little doubt but that the pendulum is swinging from the extreme degree in specialized medicine so that in a few years the normal balance between the specialist and the general practitioner will be established.

Along with the growth of specialized medicine has come the laboratory, which at the present time is the brain of practical scientific medicine. It is to the laboratory that we are chiefly indebted for all of the great discoveries in medicine and the allied sciences. The beginning of this era of laboratory work was the establishing of Von Ziemssen's laboratory in Munich in 1885.

Among the great discoveries which we owe to the laboratory are Pasteur's work on pathogenic microbes, in which he brought out the theory of protective inoculation against certain infectious diseases. Later on he gave to the medical world the results of his studies on rabies and anthrax, which have been of immeasurable service to mankind throughout the civilized world.

About the same time Koch introduced a new method for the isolation and pure culture of bacteria which is essentially the same as is now in use. In 1874 Ehrlich improved the method of staining smears which had been worked out by Weigert three or four years previously. This opened the door to the study of a great number of microorganisms and has proven one of the most important diagnostic criteria in the practise of medicine. As a result of Weigert's and Ehrlich's laboratory technique the spirillum of relapsing fever was discovered in 1873 by Obermeier and the parasitic amœba in dysenteric stools by Loesch in 1875. Koch was able to grow anthrax bacilli for the first time in artificial media in 1875. In 1879 Neisser announced the discovery of the gonococcus. In 1880 Pasteur presented his monograph on the study of the streptococcus and the staphylococcus which had been isolated for the first time by him two years previously. About the same time Eberth described the typhoid bacillus as the cause of the continued fever known as typhoid. Laveran discovered and described the plasmodium of malarial fever, November 6, 1880.

Perhaps the most important of these discoveries and the one which attracted instantly the most wide-spread attention among the laity as well as the medical profession was that of the tubercle bacillus by Koch in 1882. Tuberculosis had been known and observed for centuries, but the microorganism which produced it had eluded all of the keenest observers up to that time. Another almost equally important discovery made by Klebs in 1883 was the diphtheria bacillus; its causal relation to diphtheria was demonstrated by Loeffler in the same year. Along about this time came the discovery of the tetanus bacillus, the colon bacillus, the meningococcus, the bacillus of Malta fever and a number of others. Still another contribution along this line was that of Smith and Kilbourne, who discovered that Texas fever was transmitted by the cattle tick. However, some years antedating the announcement of Smith and Kilbourne, Dr. A. F. A. King, of this city, read a paper before this society in which he expressed the belief that malaria was transmitted by the mosquito. This may, and probably did, give a hint as to the transmission of certain infectious diseases, which led to valuable discoveries, chief of which was that of Reed and Carroll of this city, who demonstrated that yellow fever was transmitted by a certain species of mosquito; thus corroborating Dr. King's theory. As a result of this discovery Cuba was made safe to the traveler and the completion of the Panama Canal was made possible.

Another notable contribution to practical bacteriology was the discovery in 1896 by Widal of the agglutination test for typhoid fever, upon which the present-day differential diagnosis between typhoid and other continued fevers rests.

With the mention of one additional important discovery I will pass on to developments in other fields. Perhaps none of these mentioned heretofore have arrived at a more prominent place in the history of valuable discoveries than Wassermann's serodiagnosis

of syphilis in 1907 and Schaudinn's discovery of the *Treponema pallidum,* two years earlier, in 1905.

Medical science is indebted to the pathologists for many important and valuable contributions during the past fifty years. As a result of their investigations the pathology of many of the diseases to which human flesh is heir has come to be more or less understood. The progress of physiology has kept pace with pathology along allied lines, but its scope is much more comprehensive than the latter, as it invades the domain of chemistry to some extent. This field of medical research has contributed more of practical value than any other, with the exception of bacteriology, with which it is also closely linked. In this field has been developed the knowledge of the ductless glands which at the present time is attracting so much attention. It was Brown-Sequard who, in 1891, called attention to this domain of the body.

Charcot laid the foundation for the later developments in psychoanalysis by his studies on hysteria a half a century ago. Freud in the present generation has carried this branch of medicine to the point of practical application. To Golgi's method of staining, which was given to the medical profession in 1873, the knowledge of the histology of the nervous system is attributable.

The place which Lister occupies in relation to the developments of surgery is recognized by the entire scientific world. Not infrequently he is alluded to as the father of modern surgery. As he antedates the period covered by this paper I will not dwell further upon his achievements, although to him may be attributed the foundation of aseptic surgery.

The advancements in this branch of medicine are so many and spectacular as to well nigh overwhelm the chronicler of a brief history of medical progress.

One of the earliest important steps in the progress of surgery was the introduction of steam sterilization of dressings and instruments in 1886 by von Bergmann. This superseded corrosive sublimate antisepsis then in use.

Esmarch, in the early seventies, called attention to his method of controlling hemorrhage at operations by bandaging the limb above the site of operation, thereby giving the operator an almost bloodless field and greater freedom for exact work, and at the same time saving the patient from unnecessary loss of blood.

Sir Spencer Wells went a step farther and devised the clip or hemostatic forcep to pick up the individual bleeding points at the site of operation, this doing away with Esmarch's method.

Local anesthesia by ether spray was introduced by Richardson in 1886 and cocaine by Anrep and Kohler about the same time. Dr. Corning, in 1885, described the results of his experiments in spinal anesthesia, although the claim for this new and important discovery has been made in Germany on behalf of Bier in the same year. Six years later Quincke called attention to the importance of a study of cerebro-spinal fluid in certain local and system diseases.

As a result of the work of Corning, and later Quincke, Crile developed his method of anocia-association, which for a brief time was widely used.

The strides in abdominal surgery during the past twenty-five years have been so rapid, varied and extensive as to make it impossible to select any high points for mention, since they all come well within that category.

It may not be inappropriate to call attention in passing to the fact that much of the recent progress in field surgery has been due to the great surgical clinics which have been developed during the past twenty years, both here and abroad.

The care of the mother at child-birth is the oldest branch of the practise of medicine and, without doubt, the most important to the future of the world. Whereas, there have been no startling developments in this branch of medicine yet the obstetrician has kept pace with the surgeon in modern methods and asepsis.

The progress in the field of diagnosis rests

upon the developments in bacteriology, physiology, histology and chemistry. A history of any one of these necessarily describes diagnostic progress.

In therapeutics the most noteworthy advance was the gradual transition from the old-time so-called gunshot prescription to the simple single drug prescription devoted to the specific need for which it is to be used. Some of the more beneficial additions to modern therapeutics are chloral as a hypnotic and the salicylates for the relief of so-called rheumatic affections.

The discovery of the hemostatic effects of certain drugs by means of which hemorrhage beyond the reach of the hemostatic instruments may be controlled has been a great boon to the physician and to the surgeon.

In the eighties the antipyretic drugs were given to the profession and were soon eagerly appropriated by the laity for the relief of vague and distressing pains in one part of the body or another.

A very important contribution to therapeutics was the introduction of von Behring's anti-diphtheritic serum in 1893. Another was the introduction of anti-typhoid inoculation.

The modern synthetic sleep-producing drugs, of which trional and sulphonal are examples, were introduced in 1893. Novocain, which is widely used, was discovered by Einhorn in 1905. No more important remedial agent has been given to the medical profession than Ehrlich's salvarsan in 1909, which has done much to rob syphilis of its terrors both to the community and to the individual.

The multiplicity of pharmaceutical and biological products is bewildering and a large percentage of them are useless and serve merely to enrich the manufacturers and to deceive for a time the credulous public.

The most spectacular of all the discoveries in modern medicine is that of the X-ray, which Roentgen announced in 1895. Not only has it proven a useful therapeutic agent but it holds a commanding position among diagnostic methods. Another therapeutic agent which aroused a great deal of attention was the introduction of radium for the treatment of cancer and indolent ulcer, the exact value of which has not, as yet, been definitely determined. The trend of to-day in therapeutics is to limit the amount and number of drugs used, and to employ hygienic and dietetic measures in the treatment of disease, and to reach out after prophylactic methods.

In passing from a consideration of therapeutics I may be pardoned for calling attention to the fact that the medical profession differs from all others in being the only one which, in its practise, is self-destructive, by teaching the public laws of social hygiene and of preventive measures.

A necessary development in the scientific care of the sick was the advent of the trained nurse, who came to be recognized as a necessity in the latter part of the nineteenth century. Nursing as a profession was suggested by Dr. Samuel Gross about fifty years ago, and shortly thereafter, on August 1, 1875, the first training school for nurses was formally opened at Bellevue Hospital, N. Y. Soon, other training schools were established, until at the present time training schools for nurses are to be found in great numbers throughout the civilized world.

It would be difficult to conceive the possibility of carrying out the modern methods of caring for the sick without the invaluable aid of that great body of earnest and intelligent women who go to make up the nursing profession. One has only to mention the Red Cross to realize the deep root the nursing profession has taken in the social fabric of the world.

Of necessity the scheme of medical education and the development of medical libraries have grown with the needs arising out of the progress of the profession during the past half century.

Having considered briefly a few of the more important epoch-making discoveries which have marked the progress of the medical profession during the past half century, may we not draw therefrom encouragement to look at the future, rich in the promise of developments which will progressively lessen

disease, wretchedness, poverty and despair. This, ladies and gentlemen, is truly the highest mission of the medical man.

There remain many problems which in our day are yet unsolved and in each decade new questions will arise.

Among some of the more pressing problems which face the medical profession of to-day is the discovery of the cause of cancer; a more perfect control of tuberculosis, leading to its ultimate eradication; the ultimate elimination of venereal diseases through compulsory registration, and a wider dissemination of the knowledge of these diseases among the laity, a more accurate knowledge of the etiology, pathology and care of epilepsy, the sufferers from which are the most pathetic and dependent members of society; the relief of and the ultimate prevention of nutritional diseases through a more perfect knowledge of dietetics and hygiene on the part of physicians and the public; a crusade against the ever-increasing number of those, especially the young, who are afflicted with defective eyesight, due chiefly to improper lighting of homes and school rooms; and too frequent attendance at motion picture entertainments.

In closing I can not do better than to leave with you the thoughts embodied in an address by that great medical teacher, Dr. Keen, who says:

> In all humility, but with earnestness, medical men tender you their labor and practise, in the hospitals, on teacher's platform, and in the laboratory. What they expect and look forward to is appreciation, not of the individual, but of the aggregate work, and cooperation on the part of the public, for the immediate results of our work are at the same time humane and practical. The reduction in your death rate of one in a thousand means, beyond the saving of one life, a lowering of more than thirty in the total number of cases of sickness, and therewith prevention of much anxiety, wretchedness, and financial loss or ruin in as many families. Results like these are liable to be accepted as natural. It should not be forgotten, however, that they are obtained only by the work of medical men who labor for the good they can do, often as hermits, unknown, unappreciated, always bent upon the diminution of the number of problems which hitherto were deemed hopeless.

William Gerry Morgan

Washington, D. C.

THE SCIENTIFIC BASIS OF SCIENCE TEACHING

The article on "The Scientific Teaching of Science" in the issue of October 15, 1920, is both suggestive and disappointing. It is suggestive because it is the record of an experiment in the methodology of science teaching; it is disappointing because the title leads one to hope that some one has at last accumulated the necessary fact basis for the scientific teaching of science, yet the article presents no such facts.

The author says that "a student will much more rapidly develop the right mental attitude by discovering facts for himself, even though they were known before, than by memorizing a multitude of facts discovered by other people." If this statement were challenged it would be quite impossible in the present state of our knowledge for the author to substantiate his point of view with facts. Probably the statement is true but the business of science is to provide a fact basis for our knowledge and establish principles indisputably. Furthermore it must not be supposed that these two alternatives exhaust the methods of procedure. It is conceivable that a student might develop the right mental attitude more quickly by imitation, following through the steps of discovery taken by some original investigator than by blundering around in a problem of his own. Whether he will or not must be determined by careful experiment, record of results, and this not with a single student, but with many.

There can be no question but that it is a very important thing both in the university and in the earlier schools to develop in the student the power of creative thought. The author of the article records an experiment in progress for three years in the scientific department of a university in which the customary laboratory-lecture-quiz method was re-

placed by a "group method" in which each pupil followed a line of investigation for himself. The results of the three years' experiment he states in the following terms: "and as the course continued, the method seemed to them (the students) increasingly desirable and successful." It seems pertinent to enquire how this was determined. Would it not be possible to present the evidence in favor of this type of work in a more concrete way? In fact, if such an investigation is to be a real contribution to the science of science teaching, must the evidence not be presented in a more concrete way?

It is not the aim of the present article to question the value of the article mentioned. It is its ambitious title that challenges criticism. The average science teacher, even the university teacher, is not yet aware of the fact that the science of science teaching must proceed in exactly the same way that other sciences have proceeded. The science teacher must awake to his pedagogical problems, these problems must be clearly defined and we must proceed to their solution by the patient accumulation of facts, formulation of tentative hypotheses, discovery of additional facts frequently by experimental methods, and on the basis of such facts we must reason to the correct solution of the particular problem. To get at the desired facts methods must be devised for the evaluation of processes, for measurement of results and these results must be capable of accurate mathematical expression. Imagine a chemist who is investigating the problem of the economic production of some industrial product presenting his results to a scientific body with the statement that "the method seemed to them (the workmen) increasingly desirable and successful" and having back of that statement no facts which he could present, no data to convince his audience. I am not criticizing Mr. MacArthur's statement. To make even such an indefinite statement is a valuable contribution at present to the methodology of our science instruction, but it shows the pitifully small progress that has been made in the science of science teaching. Until the science teachers of the country realize that pedagogy is a science, that the problems of science teaching are clear and definite and must be solved as all science problems have been solved, we can make little progress in our science instruction.

Mr. MacArthur would make the chief aim of science instruction the development of creative thought or the ability to think scientifically, and this not only in the graduate school but in the elementary school.

> It is equally important that the beginnings of a science be taught by the scientific method as that graduate work be so carried on. For the early years in any science should be given largely to discovery and original research, as are the early years of childhood. Thinking and first-hand contact would better come early, else they may never come.

Personally I heartily endorse this statement. The discovery of the importance of the scientific method of thinking and its application to the problems of life is one of the great if not the greatest contribution of science to the life of mankind and it is the greatest contribution that science teaching can make to the life of the individual. Yet in a class of thirty-eight principals and superintendents this last summer to whom was submitted a list of aims of the elementary science of the high school with the request that they number them in order of importance, this matter of training students in the scientific method of thinking was placed nine in the list of ten. This indicates—much additional data is required to prove it—what I believe is the general impression among the executive officers of the secondary schools that training in scientific thinking is a relatively unimportant thing in science instruction. Indeed science instruction is not deemed a matter of great importance. Less than half the high schools of Illinois (48.5 per cent.) require any science for graduation. In 18.8 per cent. of them the requirement is satisfied with one half year of physiology.

Is it not high time that the science teachers of the country be organized into a national association

(*a*) to enlist in active propaganda to impress the community at large and the educational fraternity in particular with the importance of science instruction;

(*b*) to discuss and agree upon the aims of science instruction, their relative importance, and proper grade placement;

(*c*) to discuss and agree upon the principles of selection of the subject-matter for the curriculum and the placement of this subject-matter in the various levels of the school;

(*d*) to stimulate accurate scientific investigations along the above lines and also in the methods of teaching science;

(*e*) to devise tests to determine in how far we are succeeding in accomplishing the desired aims of science teaching by the methods in vogue;

(*f*) to employ a national secretary for part time at the outset and ultimately for all of his time who would extend the influence of the organization, make it efficient and coordinate the work of individual investigators along the above lines.

Elliot R. Downing
The School of Education,
University of Chicago

SCIENTIFIC EVENTS

BIOLOGICAL SURVEY OF THE STATE OF WASHINGTON

During the past year biological investigations of the distribution and habits of the birds and mammals of the state of Washington have been continued by the Bureau of Biological Survey, U. S. Department of Agriculture, in cooperation with the State College of Washington, and the State Normal School, Bellingham, Washington. Early in July, 1920, there was begun a biological cross-section of the state, which, when completed, will extend from Bellingham on Puget Sound to the Pend d'Oreille country in the extreme northeastern corner of the state. During the summer season more than 200 miles were traversed by pack train in the northern Cascade Mountains, the party consisting of Professor William T. Shaw, State College of Washington; J. M. Edson, State Normal School, Bellingham, and George G. Cantwell and Dr. Walter P. Taylor, of the Biological Survey, the last named being in general charge of the work. During the fall months Mr. Cantwell continued the cross-section, making studies in the Okanogan Highlands just south of the Canadian boundary between Oroville and Marcus, Washington. Contrasts in the fauna and flora as thus far developed are marked, and indicate that when the work is completed, materials will be available for a significant treatment of an interesting ecologic transect. It is hoped to complete the field work in the state during the present year.

THE PRESERVATION OF NATURAL CONDITIONS

The Ecological Society of America's Committee on the Preservation of Natural Conditions has been listing and describing areas with original flora and fauna, preserved and desirable for reservation for scientific purposes, and is now just entering on the more extensive field work, with three additional joint chairman added. The plan of work and men in charge are as follows: Professor V. E. Shelford, University of Illinois, Urbana, Ill. (senior chairman, research and publication) is continuing preparation of the list which is to serve as a manual on natural areas with sections on the care, management and uses. R. B. Miller, state forester, Urbana, Ill. (chairman, publicity state organization) wishes to enlist the cooperation of one organization interested in science in each state and province. Dr. F. B. Sumner, Scripps Institution, La Jolla, Calif. (chairman, organization of research interests) is working on a union of research interests in natural areas, as represented by scientific societies, museums, and universities, into an organization to provide needed funds. C. F. Korstian, U. S. Forest Service, Ogden, Utah (chairman, Natural Areas in National Forests) is working on the selection of suitable natural areas which may be set aside within the existing national forest. Those having knowledge of areas preserved suitable for preservation, es-

pecially those who have studied special areas, are requested to communicate with V. E. Shelford at once as the list is soon to be completed.

SCIENTIFIC LECTURES AT OTTAWA

Members of the Department of Mines, Canada, are giving in the auditorium of the Victoria Memorial Museum, Ottawa, lectures as follows:

March 4: "The building of the continent," by D. B. Dowling, geologist.
March 11: "The anthropological field in Canada," by Dr. Edward Sapir, anthropologist.
March 25: "Zoological work in Canada," by R. M. Anderson, zoologist.
April 8: "A recent chapter in the geological history of Canada" (illustrated with slides of the Greenland Ice Cap), by Edward M. Kindle, paleontologist.
February 12: "The fur-bearing animals of Canada," by Clyde L. Patch.
February 19: "The birds of Bonaventure Island" (with motion pictures), by Clyde L. Patch.
February 26: "The Canadian Arctic coast," by K. G. Chipman.
March 5: "Wanderings with the Eskimo," by D. Jenness.
March 12: "Roads to wealth in our northern forest, or mineral development in northern Ontario" (with motion pictures), by T. L. Tanton.
March 19: "Hunting giant dinosaurs in the Badlands of Alberta," by Charles M. Sternberg.
March 26: "Ottawa three times submerged and how we know it" (with motion pictures), by M. E. Wilson.
April 2: "Conquering the desert with irrigation" (with motion pictures), by Harlan I. Smith.
April 9: "Asbestos or fireproof cotton" (with motion pictures), by R. Harvie.
April 16: "My summer among the Ojibwa Indians," by F. W. Waugh.
April 23: "The frogs, salamanders and snakes of Ottawa," by Clyde L. Patch.

THE RESIGNATION OF PROFESSOR FLINT

Yale University announces the resignation on account of poor health of Dr. Joseph Marshall Flint, professor of surgery since 1907, to take effect at the close of the present university year. Dr. Flint is planning to go to his home in California after commencement. The following resolutions have been passed by the faculty of the medical school:

The faculty of medicine have learned with deep regret of the resignation of Dr. Joseph Marshall Flint from the chair of surgery, which he has so ably and faithfully filled since 1907.

Coming to this university with a broad and thorough scientific training, and with high ideals, Dr. Flint became the original full-time professor, and has done great service both by precept and by example, in upholding high standards of teaching, research and practise.

He has always shown great tenacity of purpose and devotion to principle. Whatever success the Yale School of Medicine may have in the future will have been made possible by the loyalty and steadfastness of Dr. Flint and Dr. Blumer, whose joint service at a time of great stress succeeded in tiding over the crisis that economic conditions and new developments in medical education had brought on.

The faculty desire to place on record their high appreciation of Dr. Flint's services to the university, to the nation and to science, and to express their keen sense of loss at his leaving. They wish him full and speedy recovery of health and a large measure of success in his future work.

THE INTERNATIONAL UNION OF RADIO TELEGRAPHY

An American Section of the International Union of Scientific Radio Telegraphy has been formed and has adopted a constitution which provides:

1. The American Section of the International Union of Scientific Radio Telegraphy shall consist of an executive committee and of the members of the technical committees provided for in paragraphs 2 and 3 below.

2. The executive committee of the American Section shall consist of the chairmen of the divisions of physical sciences and of engineering of the National Research Council (ex officio); one member each of the following: The Army, the Navy, the Department of Commerce, the Institute of Radio Engineers; four members at large to be appointed by the president of the National Academy of Sciences; and (ex officio) officers of the International Union of Scientific Radio Telegraphy resident in the United States.

3. The duties of the executive committee shall be: To act as the representatives of the United States in the International Union of Scientific Radio Telegraphy in the interim between its regular meetings; to organize the American Section, including its technical committees, and to arrange for a meeting of the American Section shortly preceding each regular meeting of the International Union; to select delegates to the meetings of the Union; and in general to deal with all scientific radio questions involving the participation of the United States. The chairman of the executive committee of the American Section shall be a member (ex officio) of the Division of Foreign Relations of the National Research Council.

The first officers of the section are:

Chairman, Louis W. Austin.

Corresponding secretary, Augustus Trowbridge, chairman, division of physical sciences, National Research Council (*ex officio*).

Technical secretary, J. H. Dellinger.

Executive committee, Louis W. Austin, U. S. Navy; Comfort A. Adams, chairman, division of engineering, National Research Council; E. F. W. Alexanderson, Radio Corporation of America; J. H. Dellinger, Bureau of Standards; Alfred H. Goldsmith, editor, *Proceedings* of the Institute of Radio Engineers; F. B. Jewett, Western Electric Company; A. E. Kennelly, Massachusetts Institute of Technology; Major-General G. O. Squier, chief signal officer, U. S. A.; Lieutenant-Commander A. Hoyt Taylor, U. S. Navy; Augustus Trowbridge.

The following have been appointed chairmen of technical committees:

Committee on Static, Dr. Austin.

Committee on Transmission, Dr. Kennelly.

Committee on Physics of the Electron Tube, Dr. Jewett.

Committee on Radio Interference (not yet appointed).

SCIENTIFIC NOTES AND NEWS

Dr. C. L. Alsberg, chief of the Bureau of Chemistry of the United States Department of Agriculture, has been appointed director of the Food Research Institute which is to be established at Stanford University by the Carnegie Corporation. He will assume his new work on July 1.

Dr. Edward Laurens Mark, for forty-four years instructor and professor of zoology and anatomy at Harvard University, will retire from active teaching at the close of this year and has been appointed Hersey professor of anatomy emeritus.

Dr. Robert F. Ruttan, head of the department of chemistry, McGill University, has been appointed to succeed Dr. Duncan G. MacCallum, as administrative chairman of the Advisory Council for Scientific and Industrial Research in Canada.

Dr. Charles W. Richardson received the honorary degree of doctor of science recently from the George Washington University.

The University of Cambridge has awarded its doctorate of laws to Sir Patrick Manson, of the London School of Tropical Medicine, and Dr. Albert Calmette, of the Paris Pasteur Institute.

Sir W. H. Bragg has been elected president of the London Physical Society. The vice-presidents who have filled the office of president are Dr. C. Chree, Professor H. L. Callendar, Professor R. B. Clifton, Sir Richard Glazebrook, Sir Oliver J. Lodge, Professor C. H. Lees, Professor A. W. Reinold, Sir Arthur Schuster, Sir J. J. Thomson and Professor C. V. Boys.

We learn from *Nature* that the twenty-fifth anniversary of the discovery of the "Zeeman effect" will take place on October 31 next. A committee has been formed by scientific men in Holland to mark the occasion by showing their appreciation of the importance of the discovery and of the distinguished services which Professor Zeeman has rendered to science. It is intended to raise a fund to be placed at his disposal for researches to be conducted in the physical laboratory of the University of Amsterdam.

Mr. George L. Harrington recently returned from South America, where he had been engaged in private work, and resumed work in the Alaskan Division of the U. S. Geological Survey. He has now returned to South America.

MR. J. W. GIDLEY, assistant curator of vertebrate paleontology at the National Museum, left Washington in January for a two months' exploratory trip in Arizona, California and Nebraska for the U. S. Geological Survey and to secure fossil mammals for the museum collection. Important finds of Pleistocene mammal remains in the vicinity of Benson, Arizona, are reported.

SIR G. SIMS WOODHEAD has retired from the editorship of the *Journal of Pathology and Bacteriology,* which he founded in 1893, and is succeeded by Drs. A. E. Boycott and H. R. Dean.

THE Brown Chapter of Sigma Xi held its initiation and banquet on March 4. Two members of the faculty, four graduate students and seventeen members of the senior class were elected members. The speaker at the banquet was Dr. Oscar Riddle, of the Cold Spring Biological Laboratory of the Carnegie Institution.

DR. ARTHUR F. COCA, of the medical school of Cornell University, editor of the *Journal of Immunology,* gave an address on Hypersensitiveness before a recent meeting of the University of Kansas chapter of Sigma Xi. Dr. Coca had been studying, for a few weeks previous, the hypersensitiveness of Indian students of Haskell Institute of Lawrence.

SIR NORMAN MOORE, president of the Royal College of Physicians, has appointed Dr. Herbert Spencer to deliver the Harveian oration in October and Dr. Michael Grabham, of Madeira, to deliver the Bradshaw lecture in November. Dr. Major Greenwood will deliver the Milroy lectures in 1922.

SHERBURNE WESLEY BURNHAM, professor of practical astronomy at the University of Chicago from 1902 to his retirement in 1914 and astronomer at the Yerkes Observatory, died on March 11, in his eighty-third year.

PROFESSOR CHARLES H. FERNALD, from 1886 to 1910 professor of zoology and entomology at the Massachusetts Agricultural College, and for several years director of the graduate school, died on February 22, aged eighty-three years.

DR. WILLIAM FISKE WHITNEY, John Barnard Swett Jackson curator of the Warren Anatomical Museum of Harvard University, died at his home in Boston on March 4, in the seventy-first year of his age.

DR. JOSEPH RANSOHOFF, professor of surgery at the University of Cincinnati, died on March 10.

WILHELM VON WALDEYER, professor of anatomy at the University of Berlin, has died at the age of eighty-five years.

THE deaths are announced of William Odling, lately professor of chemistry at Oxford University, and of Robert Bellamy Clifton, lately professor of experimental philosophy. Dr. Odling was ninety-one years of age, and Dr. Clifton eighty-five years of age.

AT a meeting of the council of the American Mathematical Society held on February 26, 1921, it was voted to accept the invitation of the American Association for the Advancement of Science to become one of the scientific societies affiliated with the association. According to the arrangements for the affiliation of scientific societies with the American Association all members of the newly affiliated society, who are not already members of the association, have the privilege of becoming members of the association without the payment of the usual entrance fee.

THE United States Civil Service Commission announces an examination for the position of superintendent and director of biological stations in the service of the United States Bureau of Fisheries. Applicants will be rated chiefly upon education and experience. Two vacancies for the above named position now exist in the Bureau of Fisheries, one at Beaufort, N. C., carrying a salary of $1,500 per annum, and one at Key West, Florida, with a salary of $1,800. In each case the additional increase granted by Congress of $20 per month is allowed, and living quarters, unfurnished, are available, free of cost to the appointee. There are opportunities for promotions to

positions with basic salaries of $2,000 to $2,500 a year, as vacancies occur. Applications must be filed with the Civil Service Commission, Washington, D. C., prior to the hour of closing business on April 12, 1921. Prospective candidates should apply to the Civil Service Commission, Washington, D. C., for a copy of form 1312, stating the title of the examination desired.

The late Professor Emil Fischer bequeathed 750,000 marks to the Prussian Academy of Sciences, the income of which is to be used to aid young German chemists doing research work in organic, inorganic or physical chemistry.

The *Journal* of the American Medical Association reports that the *Deutsche medizinische Wochenschrift* records that Dr. Lange, of Chicago, has sent to Professor Paltauf, of Vienna, 7,000,000 crowns collected in America. Also that another sum of $10,000 has been forwarded from America to aid the university professors. It was sent to Professor Pirquet for distribution. The Rockefeller Foundation has also appropriated $60,000 for assistance to the Vienna clinics. This sum is said to be equivalent to 40,000,000 crowns at the present rate of exchange. The salaries of the regular university professors at Vienna were increased materially last year, being 45,000 crowns, increasing by 4,000 crowns every fourth year to a maximum of 70,000. The *Münchener medizinische Wochenschrift* likewise reports that Dr. A. Stein, chief of the Lenox Hill (formerly the German) hospital, has recently sent a large sum collected in America to Frankfort-on-the-Main to be applied for scientific purposes.

We learn from the *British Medical Journal* that the London School of Tropical Medicine has arranged to send an expedition to British Guiana to investigate filariasis with the view of obtaining information as to its prevention and treatment. The expedition is being sent at the request, made shortly before he left the Colonial Office, of Lord Milner, who considered that the government required further advice as to the best method of controlling the disease. At the suggestion of Sir Patrick Manson the expedition will visit also certain West Indian islands, choosing one, such as Barbados, where the rate of attack is high, and another, such as Grenada, where it is low. It is hoped that by comparing and contrasting the circumstances of two such islands light may be thrown on the conditions which favor filaria. The leader of the expedition is Professor R. T. Leiper, director of the helminthology department of the London School of Tropical Medicine; the other members are Dr. G. M. Vevers, demonstrator of helminthology in the school; Dr. John Anderson, Dr. Chung Un Lee, and Dr. Mahommed Khalil of the Egyptian Medical Service. The expedition will sail this month.

Sir Ernest Shackleton is planning a new Polar expedition to the Arctic. He expects to be away for two years. According to the London *Times* he proposes to leave England in May or June next, and will take with him a dozen men, chiefly those who accompanied him on former expeditions. The Norwegian whaling boat *Foca I.*, bought in Christiania for this new expedition, is now lying at Tromsö, and will be delivered in England next month. In all probability *Foca I.* will go, in the first instance, to Hudson's Bay, where 150 dogs will be taken on board. Thence the expedition will proceed *via* Baffin's Bay—which will be reached, it is hoped, by the end of July, provided ice conditions are favorable—through Lancaster Sound, to Axel Heiberg's Land. Thence Sir E. Shackleton intends to explore the islands eastward to Perry Island, this being the main object of the expedition. These islands have been already visited by Otto Sverdrup, Godfred Hansen, and others, but Shackleton believes that there is still much scientific work to be done in that region. He will procure his equipment in England, and hopes to receive a quantity of the material which the English used in Archangel during the war. He was, it may be remembered, employed by the British government to see that the troops in North Russia were properly equipped for Arctic conditions. *Foca I.* is said, by experts, to be one of the

best boats in the Norwegian Whaling Fleet. It has a large and spacious deck, so that there will be plenty of room for dogs and sledges. Sir E. Shackleton has told an acquaintance in Christiania that he has given up the idea of exploring the South Polar regions, and in future will devote himself to the Artic.

THE *Journal of Industrial Chemistry* reports that the International Chemical Conference last June decided to hold the next conference in Poland, at the invitation of Mr. Kowalski. At that time the situation in that country seemed fairly settled, but since then affairs have become disturbed, and the council of the union has decided that the next meeting can not be held in Warsaw. Dr. Parsons has extended an invitation from the American Chemical Society to hold the 1921 meeting in the United States, but European chemists are not in a position to make this move. Therefore the council has decided to hold the next meeting at Brussels, at the end of June. However, Mr. Paul Kestner, president of the Société de Chimie Industrielle, will attend the Canadian meeting of the British Chemical Society as the French delegate, and will return by way of the United States, where he will attend the meetings of the American chemical societies.

AT the annual general meeting of the Association of Economic Biologists, as we learn from *Nature,* the following were elected officers and councillors for the year 1921: *President:* Sir David Prain. *Hon. Treasurer:* Dr. A. D. Imms, *Hon. Secretary (Gen. and Bot.)* Wm. B. Brierley. *Hon. Secretary: (Zool.):* Dr. S. A. Neave. *Hon. Editor (Bot.):* Wm. B. Brierley. *Hon. Editor (Zool.):* D. Ward Cutler. *Council:* Dr. W. Lawrence Balls, Professor V. H. Blackman, F. T. Brooks, A. B. Bruce, Dr. E. J. Butler, F. J. Chittenden, A. D. Cotton, J. C. F. Fryer, Professor J. B. Farmer, E. E. Green, Dr. G. A. K. Marshall and Dr. E. J. Russell. In view of the very great increase in the publishing costs of the *Annals of Applied Biology,* it was decided to establish a "Publication Fund," to which all interested in the progress of biology and in its application to the welfare of man are invited to subscribe. Sir David Prain then delivered his presidential address on "Some Relationships of Economic Biology."

UNIVERSITY AND EDUCATIONAL NEWS

AT the Founders' Day Celebration of the Johns Hopkins University, announcement was made that the trustees of the university would supplement the fund of $215,000 raised by the Alumni Association for a memorial dormitory building at Homewood, so that the total cost of the building might be provided for.

IN response to the recent appeal of the University of Edinburgh for £500,000, the sum of £200,000 has now been subscribed.

GENERAL LEONARD WOOD has conferred with the trustees of the University of Pennsylvania in regard to accepting the provostship of the university, vacant by the retirement of Dr. Edgar F. Smith.

PROFESSOR FRANK AYDELOTTE, professor of English in the Massachusetts Institute of Technology, has been elected president of Swarthmore College, to succeed Dr. Joseph Swain.

DR. GUY POTTER BENTON, formerly president of the University of Vermont, has been appointed president of the University of the Philippines, with a salary and perquisites of 33,000 pesos (normally $16,500). The place has been vacant two years.

DR. YANDELL HENDERSON, hitherto professor of physiology in the Yale Medical School, has been transferred to the Graduate School of Yale University under the title of professor of applied physiology.

DISCUSSION AND CORRESPONDENCE

SECTION L OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

HAVING been secretary of Section A during a number of years when this section covered both of the subjects mathematics and astron-

omy the writer fails to see much force in the objections raised in the February 18 number of SCIENCE to the name "Historical and Philological Sciences" for Section L of the American Association for the Advancement of Science. From the fact that the special committee appointed by the President of the Association recommended that the words "and philological" be dropped it appears that the rest of this name would have been satisfactory to the committee. If this is the case the main objection to the suggested name seems to be due to a fear that the philologists might at some future time "step in and give rise to a heterogeneous, incoherent group of workers, having no interests in common."

It is not much more than a century ago that the philologists opened for mathematical historians rich fields by the discovery of a key to the cuneiform inscriptions of the ancient Babylonians and the discovery of a key to the writings of the ancient Egyptians. The history of the ancient scientific developments is fundamentally connected with the languages of the people of antiquity and hence there seems to be little reason to object to a closer contact between the philologists and the historians of science, especially during the early stages of the development of the history of science in our country. As an instance of the fruitfulness of this contact it may be noted that L. J. Richardson, professor of Latin in the University of California, contributed an interesting article on "Digital reckoning among the ancients" to the first volume of the *American Mathematical Monthly* after it became the official organ of the Mathematical Association of America in 1916.

During the Chicago meeting of the American Association for the Advancement of Science a good beginning was made towards the encouragement of workers in the history of science in our country. It would seem that only the most serious considerations should be allowed to interfere with the continuance of this encouragement under the influence of a strong national organization. In particular, differences of opinion as to the most suitable temporary name of the section which aims to unite the workers in the history of science in our land should not be allowed to curtail seriously the efforts of those who believe in such a union. If the modern mathematicians and the modern astronomers could work harmoniously for so many years it seems clear that the historians of science have nothing to fear from the presence of the philologists, especially in so far as these two types of scientists are seeking common ground.

G. A. MILLER

UNIVERSITY OF ILLINOIS

FOSSILS—ARE THEY MERELY "PREHISTORIC," OR MUST THEY ALSO BE "GEOLOGIC"?

I AM perfectly willing in my proposed definition of "fossils" to accept a substitute for the term "age," as suggested by Professor Field in his contribution to SCIENCE for February 4, if only authorities can agree on what it shall be. Of the various terms used for geological and archeological time divisions—*era, period, epoch, age*—each have been used as designations for the time since the Pleistocene. LeConte refers to this time indifferently as "Psychozoic era," "age of man," and "recent epoch." Schuchert practically agrees with these designations, Chamberlin and Salisbury call it the "human period," Professor Field in the contribution above referred to, speaks of it in one place as the "Psychozoic era," and in another as "the recent geological epoch." For other coordinate or subordinate divisions we read in various works such expressions as "Quaternary period" and "Quaternary epoch" (Brigham), "Neolithic period," "Gunz glacial stage" (Osborn), "Sixth glacial period" (Geikie), "Reindeer period" (Lartet), "Prehistoric period" (Lubbock).

We see in the above variations in usage the usual fate of recommendations of scientific congresses when they attempt to reform and draft into the exacting service of science words that have long led a life of freedom as a part of our common vernacular.

"Prehistoric," however, is not a term of this character. From the time (1851) when it was

first coined by Sir David Wilson in his "Prehistoric Annals of Scotland" to express the "whole period" (age or epoch) "disclosed to us by archeological evidence as distinguished from that known by written records," down to the present it has retained in scientific literature its original meaning. It distinctly refers to a portion of the human period (epoch or age). I fail to find Dr. Schuchert anywhere using it in any different sense. He certainly nowhere "begins the Psychozoic era" with the "historic period" as claimed by Professor Field. In spite of the latter's protest, therefore, I fail to see wherein I have misstated his position. For in between his "mastodon" (mammoth ?) "preserved in the arctic ice," which is admitted to be a fossil and his "leaf buried in the gutter," which is not, there is a vast deal of time, from younger to older—*historic, prehistoric* and *geologic*—from only the last of which—the glacial or interglacial portion—would traces of organisms be considered fossil. Neolithic man is not fossil; some of the remains of Paleolithic man are fossil. Both are prehistoric.

Recurring to the propriety or the practise of using the term "fossil" in other than its strict scientific sense, the question presents itself: how about the use of other geological terms in analogous senses? In an article in the last *Geographical Review* entitled "Race Culture and Language," the author, Griffith Taylor, is found applying the terms "inlier" and "outlier" (giving credit to geology for the idea) to certain races in Europe. The former is applied to the Basques, because they constitute an island of ancient people surrounded by younger races, and the latter is applied to the Finns because they are a body separated from the main ethnic group to which they belong, and with which they were once continuous. Most of us, I think, will be disposed to congratulate Professor Taylor on the felicity of these expressions, regardless of how much Professor Field may shake his head over the liberty taken with geological terminology.

ARTHUR M. MILLER

UNIVERSITY OF KENTUCKY

THRICE TOLD TALES

TO THE EDITOR OF SCIENCE: Referring to the letters of Professor Wood[1] and Professor T. C. Mendenhall[2] (*semper juvenis*), I too have a story about the Lick Observatory; and following their lead, hasten to make it public; and then will patiently wait for the various transmutations. Perhaps some one will prove a similar occurrence in the days of Archimedes!

Going up to the observatory in the stage with its load of Saturday night tourists, suddenly one of them asked aloud—"Who was this Mr. Lick, any how? Did he invent the telescope?"

Shades of Galileo! It *is* time to come forth and be filmed as Professor Mendenhall suggests. In the cast we could have a tourist, same species as Professor Mendenhall's "damned fraud" person. He will be shown asking—"Who is this Mr. Galileo anyhow? Did he build this leaning tower?"

ALEXANDER MCADIE

BLUE HILL OBSERVATORY,
February 16

AMERICAN PUBLICATIONS AND INTERNATIONAL EXCHANGE

IN a note just received from Professor Charles Julin, of Liége, he mentions the present unequal international exchange and how difficult it is, in consequence, for the Belgian universities to obtain foreign publications. He says that separata from our American workers will be most welcome, and asks that this suggestion be brought to our students. I think the fact is quite generally appreciated, but it can do only good to bring it again to our attention.

MAYNARD M. METCALF

SCIENTIFIC BOOKS

History and Bibliography of Anatomic Illustration. By LUDWIG CHOULANT. Translated and Edited by MORTIMER FRANK. The University of Chicago Press, 1920.

[1] SCIENCE, January 14, 1921.

[2] SCIENCE, February 11, 1921.

The purpose of this book is a presentation of the history and bibliography of representations of human anatomy by graphic means. Due consideration has been given both to anatomic illustration and to representations belonging to the graphic and plastic arts.

While engaged in the preparation of the list of the anatomists of the world[1] one of the most useful works of reference was found to be J. Ludwig Choulant's "Geschichte und Bibliographie der anatomischen Abbildung," which had been published in 1852 in Leipzig by this energetic physician. It was likewise of great value in studying the sources of anatomical literature[2] and in other ways has proven its value as an aid in the study of the history of anatomy. Its importance in the history of medicine is indicated by the nine references to Choulant's work in Garrison's "History of Medicine."

Unfortunately this important work has long been out of print and there are few copies available for the younger generation of students. It was thus with great interest that we welcomed the announcement from the University of Chicago Press of the forthcoming translation of this important historical document by Mortimer Frank, a Chicago physician who had already earned fame by his contributions to medical history. As an associate editor of the *Annals of Medical History* he made his influence felt in the development of this important journal. His great collection of early medical works and engravings, since his lamented death deposited in the library of the University of Chicago, gave him a grasp of his subject such as few men are given to attain.

Dr. Frank did not live to see his book off the press and his untimely death was greatly mourned by the profession at large but especially was his loss keenly felt by those whose interests were similar to his own. His friend, Fielding H. Garrison, acted as editor and saw the book through the press.

1 Published in Eycleshymer's "Anatomical Names," New York, 1917, pp. 177–354.

2 This subject was discussed by the writer in *American Naturalist*, LI., 193–208, April, 1917.

The book is a handsome volume and the press-work is well up to the standard of the other publication from this press. Garrison's memorial notice of Mortimer Frank introduces the book to the reader. This is followed by Frank's biographical sketch of Choulant, thus making available for the first time in English, the life of this important worker. The succeeding pages are occupied with the translation of the history and the reproduction of the bibliography to which important additions are made, thus revising and bringing the work up to date.

The illustrations of the original publication are well reproduced in the translation and add great value to the work in the hands of students of art. An unfortunate feature is the arrangement of the descriptions of the figures, these being placed in the back of the book with no references to them on the plates. In this arrangement Dr. Frank simply followed Choulant's plan in the German edition.

Choulant's original discussions of the various artists who forwarded the study of anatomy by their illustrative work may seem to the art student somewhat unequal and this same inequality is apparent in the translation; but in making such a criticism one must keep in mind that Choulant's idea was the discussion of the work of each man as he had aided in the development of anatomical illustration. His very brief account of Michaelangelo's work is not in any disparagement of this eminent Italian's work but is due to the fact that the great sculptor left few contributions to anatomical illustration.

The history and bibliography already has its place in the literature and Dr. Frank's translation will make the work available to all students of the subject. While we regret that our fellow worker was not given the joy of seeing the book off the press, yet we may rejoice that he was enabled to leave the work so nearly complete as to warrant the publication of this important contribution.

Roy L. Moodie

College of Medicine,
University of Illinois

SPECIAL ARTICLES

AMŒBOID MOVEMENT, TISSUE FORMATION AND CONSISTENCY OF PROTOPLASM[1]

1. In 1901 we found through testing by direct means the consistency of the protoplasm that in the blood cells of *Limulus* amœboid movement depends primarily upon alternating changes in the consistency of the protoplasm, a phase of liquefaction being followed by a phase of hardening. There may be added to these changes in consistency changes in surface tension.[1] Subsequently we showed in experiments in which we likewise tested the consistency of the cells directly that the consistency varies under different conditions, that these variations correspond not only to the pseudopodial activity, but also to the agglutinability of the blood cells and to the formation of tissue like structures from previously isolated cells,[2, 3] that these changes due to stimulation explained the stereotropism of tissue cells,[2, 4] that they played a part in the processes of inflammation,[1, 2] phagocytosis,[4] and thrombosis.[5, 6, 7, 8] More recent observations in 1919 showed that it is possible to vary greatly the character of the amœboid movements and that the changes in the amœboid movements correspond to the changes in the consistency of the protoplasm; these observations suggested that the taking up of fluid from the surrounding fluid on the part of the cells is an important factor in these processes.[9] We furthermore showed that certain phenomena of wound healing can be imitated in this experimental amœbocyte-tissue and that the formation of giant cells which takes place in sensitive cells in contact with a foreign body represents an application of the same principle.[9] Here we have to assume that the process of liquefaction may proceed so far that two cells may flow together. We also pointed out that variations in the hydrogen ion content of the cells under the influence of stimulation might explain these changes.

2. A continuation of these experiments in Woods Hole last summer showed that in the blood cells of *Limulus* it is possible to produce graded variations in the character of the pseudopods and amœboid movements through graded changes in the osmotic pressure in the surrounding medium. Again we find correspondence between the consistency of the protoplasm and the character of the pseudopods and amœboid movement. A particularly great fluidity of the protoplasm could be produced through the use of a slightly hypotonic solution of KCl. In this case the change in consistency became so marked that it affected not only the ectoplasmic layer of the cell, but extended to the whole of the granuloplasm. There is reason to assume that these changes are associated with the taking up of fluid from the surrounding medium. Under those conditions a very peculiar phenomenon which we described previously, a circus movement of the whole cell exoplasm as well as of the granuloplasm, can be produced regularly. These movements, however, take place only if the temperature of the surrounding fluid is sufficiently high. It does not occur in cells kept at a temperature of 10°.

3. Exposure of the blood cells to a temperature of approximately 40°–42° for a short period of time produces in the periphery of

1 From the Department of Comparative Pathology, Washington University, and from the Marine Biological Laboratory, Woods Holl.

1 Leo Loeb, *Jour. Med. Research*, 1902, VII., 145.

3 Leo Loeb, *Biological Bulletin*, 1903, IV., 301.

2 Leo Loeb, *Virchow's Archiv.*, 1903, CLXXIII., 35.

4 Leo Loeb, *Anatomical Record*, 1912, VI.

5 Leo Loeb, *Virchow's Archiv*, 1905, CLXXXV., 160.

6 Leo Loeb, *Hofmeister's Beitraege z. Chem. Physiol. u. Pathol.*, 1904, V., 191.

7 Leo Loeb, *Pflueger's Archiv*, 1910, CXXXI., 465.

8 Leo Loeb, *Biochem. Zeitschrift*, 1910, XXIV, 478.

9 Leo Loeb, "The movements of the Amœbocytes and the experimental production of amœbocyte (cellfibrin) tissue," Washington University Studies, Scientific Series, 1920, Volume VIII., 3. (Here a general discussion of the subject is given.)

the blood cells the appearance of multiple drops into which the granuloplasm moves subsequently as it does into typical pseudopods. Transition can be observed between these drops and the typical pseudopods.

It is also possible to produce experimentally in the amœbocytes structures which very closely resemble ova in which maturation membranes have formed. Jacques Loeb has formerly shown that this formation depends upon a proces of cytolysis. In the blood cells these structures appear under conditions in which the cell has taken up fluid from the surrounding medium and the consistency of the protoplasm resembles that of a liquid. All kinds of transition between these structures, drop pseudopods and the typical tongue-like pseudopods can be found. These and other observations very strongly suggest that the formation of pseudopodia, the appearance of drops at the surface of the cells and the formation of fertilization membranes are related phenomena and that the latter two conditions represent extremes in a process which, when acting in medium intensity, leads to the formation of the typical pseudopodia.

4. Through changes in the consistency of the protoplasm in the blood cells of *Limulus* it is possible to imitate the structures corresponding to different tissues. Especially did we obtain in certain cases through an increase in the consistency of the cells tissues which resembled those composed of ganglia and glia cells. It may thus be possible to obtain indications as to some of the conditions which induce the cells of different tissues to assume different forms.

Leo Loeb

Washington University

THE RELATIVE NUMBERS OF TWINS AND TRIPLETS[1]

It may be of interest to call attention to a simple relation between the number of human twin and triplet births. The relation was noticed a number of years ago and I supposed it had been recorded, but a search has failed to reveal any published statement.

If $1/n$ is the proportion of twin births to all births in a large population during any period, then the proportion of triplet births during the same period is very near to $1/n^2$. The agreement of the data is often startling. Thus in 13,360,557 births in Prussia during the years 1826–1849 as recorded by Veit[2] the number of twin births is one in 89.1 and the number of triplet births one in $(88.9)^2$. In 1,339,975 births in the United States registration area in 1917[3] the number of twin births is one in 93.1 and the number of triplet births one in $(93.0)^2$.

From the statistical relations it would appear that triplets are produced by the coincidence of two independent processes occurring with equal frequencies. One of these processes by itself gives rise to twins. This relation would apply to any mode of origin of multiple births or to different combinations of them provided that each followed the rule.

The principle might be applied to the two chief explanations of multiple births as follows:

1. *Multiple Ovulation.*—Normally a single ovum is discharged from the ovaries. There is some coordinating mechanism which prevents the ripening of other ova at the same time. Suppose that as a result of a purely intrinsic factor, once in n times an ovum appears which fails to respond to this mechanism. The chance that two such extra ova will appear at the same time is once in n squared. Obviously this presupposes that the failure to respond is due to independent processes in the two ova. To put the case more concretely, suppose that the approach to maturation of an ovum is accompanied by an internal secretion which acts upon other ova and keeps them from completing the process at the same time. The overwhelming major-

[1] Contribution from the Zoological Laboratory of the University of Illinois, No. 172.

[2] Veit, G., 1855, *Monatsschrift für Geburtskunde und Frauenkrankheiten*, 6: 127.

[3] Birth statistics for the birth registration area of the United States, 1917, U. S. Bureau of the Census, Washington, 1919.

ity of the ova would be properly inhibited but occasionally an ovum would fail to respond because of some peculiarity in its organization. Suppose that such peculiarities are due to local factors appearing with a frequency of $1/n$. Then the chance that two such independent local factors will act at the same time and thereby cause the simultaneous discharge of two supernumerary ova is $1/n^2$.

2. *Monozygotic Twins and Triplets.*—Normally a single embryonic area appears in the blastodermic vesicle and through some coordinating mechanism inhibits the formation of additional embryonic areas. Suppose that once in n cases a cell or group of cells acquires physiological independence as the result of an intrinsic factor and forms a second embryonic area. The chance that two such cells or groups of cells will arise at the same time is once in n squared if it is supposed as in the previous case that the two events are independent of each other.

In order that the stated numerical relations may ensue, the important consideration in either mode of origin of multiple births is the independence of the two events which give rise to triplets. If, in the fluctuations of the general physiological state of the mother, the condition is sometimes such as to result in twins and sometimes in triplets, it is hard to see why the "square" relation should exist. For instance if it is postulated that additional ova are stimulated to complete the maturation process as a result of an unusual amount of an internal secretion and that the number of extra ova depends on the quantity of the secretion there is no reason for expecting the observed relation between one extra and two extra embryos. This difficulty seems to apply to all general agents that may be postulated as acting upon the ovaries as a whole in the cases of multiple ovulation or upon the developing embryo as a whole in the case of monozygotic twins and triplets. If, however, each supernumerary ovum is due to an independent local action and such local actions have a certain average frequency the coincidence of two such actions would give the observed numerical relation of triplets to twins.

If the explanation as stated applies to the relation between triplet and twin births it is to be expected that it will apply to quadruplets as well. In that case the expected number of quadruplets is one in n^3. Unfortunately the numbers are too small for a reliable conclusion. In the largest available collection of data, the one mentioned above, there are 36 quadruplets in 13,360,557 births or one in $(71.9)^3$ which is somewhat greater than the expected number, one in $(89.1)^3$.

As in other statistical relations the biological significance in the present instance can not be proved directly from the mass of data. When one considers the vicissitudes of fertilization, the chances of death of individual embryos, the demonstrated influence of the spermatozoon in certain cases of twinning and numerous other biological factors, to say nothing of faulty registration statistics, it is hard to believe that the simple numerical relation of triplets to twins can be more than the result of the combination of numerous and as yet unanalyzed forces. A knowledge of the fact may, however, aid in the analysis.

CHARLES ZELENY
UNIVERSITY OF ILLINOIS

THE AMERICAN CHEMICAL SOCIETY

SECTION OF SUGAR CHEMISTRY

C. A. Browne, *chairman*

Fred. J. Bates, *secretary*

(*Concluded*)

The sugar industry of Peru: CHAS. A. GAMBLE.

Electric oven for rapid moisture tests: G. L. SPENCER. This oven (patented August 3, 1920) is a convenient arrangement for passing a rapid current of heated air through a sample. The air is drawn over a heating element, composed of a spiraled nichrome wire coiled around a suitable core, and thence through the sample contained in a capsule, fitted with a gauze or metal filter-cloth bottom. The temperature of the air is controlled by a rheostat. Any substance through which a current of hot air may be passed, without melting, may be dried in this oven. Raw sugar may be approximately dried in 3 minutes and to constant weight in 10 minutes; 100 gram samples of cane bagasse are dried in less than 60 minutes; cotton saturated with water is dried in 10 minutes.

Refining raw sugars without boneblack: C. E. Coates. Raw sugars from the tropics have been refined off and on in Louisiana for a number of years. This was profitable on occasions when the margin between raws and granulated was high. During the past two years this margin has been so high as to offer exceptional profits to the refiner. A number of Louisiana sugar houses purchased raw sugars during the last six months and refined them by several different methods: Phosphoric acid and lime; sulphur-dioxide and lime; filtercel alone; activated wood charcoals. At the beginning of the campaign, the yields were several per cent. below those obtained in the standard bone black refinery process, but as the season went on this difference was diminished until at the present time the yield is about one per cent. short of good refinery practise. The yields by the various methods are nearly the same. There is no reason why melting tropical raw sugars can not become a part of the routine practise in both cane and beet sugar houses. The quality of the sugars obtained is excellent and in the case of the activated charcoals the sugars were beyond any criticism of any sort.

Recent advances in defecation: W. D. Horne. The Dorr Clarifier has been devised to remove the insoluble impurities from cane juice. Hot limed juice continuously enters the central well of the superimposed settling compartment equipped with slowly revolving scraper mechanisms. Clear juice flows from the periphery, and a thick mud is constantly withdrawn from the bottom. The Williamson Clarifier aerates a warm defecated raw sugar solution and then passes it through a long shallow heating tank provided with suitable baffles, causing all insoluble matters to rise in a scum, which is mechanically skimmed off, while clear liquor is continuously syphoned out below.

Comparative analysis of refined sugars: Frederick Bates and associates at the Bureau of Standards. A résumé was given of the results of an elaborate and exhaustive study of about 250 samples of refined sugars produced in the United States. One of the principal objects of this work was to determine the feasibility of preparing accurate specifications and definitions of the refined sugars. The work included the determination of the direct polarization, invert sugar, moisture and ash. The acidity and alkalinity were determined by developing a new method, using the hydrogen ion concentration with gratifying results. The average acidity and alkalinity was found to be small and indications are that the departure from neutral is a powerful factor in determining the properties of the sugar. In addition, the sugars were screened to determine average size of grain. A preliminary report was given on the importance of improving and applying the so-called candy test to refined sugars.

A graphic method for estimating reducing sugars in presence of sucrose: C. A. Browne. The slight reducing action of sucrose upon Fehling's copper solution introduces a considerable error in determining reducing sugars in presence of large amounts of sucrose. The author proposes a general graphic method which consists of a chart containing the reduction curves for dextrose in amounts from 0 to 250 mgs. in presence of sucrose from 0 to 5gs. The correct amount of dextrose, corresponding to the amount found, is determined by finding the curve which passes through the intersection of the coordinates for grams sucrose present (as determined by Clerget) and mgs. dextrose found. The starting point of this curve on the base line indicates the correct amount of dextrose.

Commercial production of d-Mannite: W. B. Newkirk and C. F. Snyder. At the request of the Army, the manufacture on a commercial scale of d-Mannite from manna was undertaken. The crude manna was dissolved in water in a melter heated by steam coils. The liquor was 17° Brix. It was heated to boiling and defecated. Three methods of defecation were employed. *Method 1:* .005 per cent. phosphoric acid added to hot liquor and let stand for thirty minutes, neutralized with lime, allowed to settle and the clear liquid decanted and filtered. The filtered liquor was boiled in open pan to 30° Brix (hot), placed in tank and crystallized. The crystals were separated in a large centrifugal. *Method II.:* The raw liquor was treated with 0.10 per cent. Kieselghur and filtered and the filtrate concentrated as above. *Method III.:* The raw liquor was treated with 0.5 per cent. commercial vegetable carbon and filtered and the filtrate concentrated as above. Method I. was the most satisfactory. The mother liquors from the first crystallization were concentrated to 40° Brix and allowed to crystallize; the mother liquors from the second crystallization were concentrated at 60° Brix and a third crop of crystals obtained. The mother liquor from the third crystallization was concentrated at 80° Brix and a fourth crop of crystals obtained. The final mother liquors were concentrated to 80° Brix and a fifth crop of crystals obtained. A tabulation is given of the

melting points and rotations reported in the literature. The specific rotation was determined in water solution for the yellow-green mercury line and we find

$$[\alpha]_E^{02} = -0.255.$$

Preservation of bagasse in sugar cane mill control: GUILFORD L. SPENCER. Formaldehyde has been generally used in preserving sub-samples of cane bagasse in preparing a composite sample, representative of several hours grinding. This has been ascertained to be only moderately efficient under modern milling conditions. The late M. Henri Pellet, in Egypt, suggested and used ammonia in protecting the samples. The author found this usually efficient but occasionally there is loss of sugar. This suggested the addition of chloroform and preservation of the bagasse in an atmosphere of ammonia and chloroform. This mixture is apparently very efficient. Refinery press-cake holds its polarization during several weeks in the presence of this preservative. The solution for polarization must be acidulated with acetic acid before clarification with lead subacetate.

Glass vacuum pan for laboratory use: M. J. PROFFITT.

Changes in the polarizing constants of sugars during refining: A. F. BLAKE. The Clerget sucrose value for sugars, as pointed out by Browne at the Cleveland meeting, normally exceeds the polarization by about one third the percentage of invert. This is true of raw sugars as shown by numerous analyses, but in the products of a refinery, soft sugars and syrup, the value of the ratio (S–P)/I is very low. Analyses of sugars at all intermediary stages of refining are given, in order to determine where the change takes place. It is concluded that some change takes place during defecation and filtration of low test material and in the handling of the muds and scums due to action of lime on the invert sugar, but that by all means the principal cause of the reduction of the value of this ratio is bone-black filtration. The factor is strongly negative for the first material coming off the boneblack, but increases in following portions until in the last portion it is about equal or slightly exceeds material going on. The average value of the factor for all material going on is much higher than the average coming off. Since boneblack absorbs invert from first material and gives it up to later material it is supposed that by selective action it might absorb more levulose than dextrose. This is proved by tests on invert sugar. Another cause is the molecular rearrangement of dextrose and levulose into glutose, etc. A high value of the ratio in refined products indicates inversion during refining. Losses of sucrose figured upon Clerget values exceed those figured on polarization, while losses of organic material are much less.

A report on the sugar industry of France since the war: T. H. MURPHY. The French sugar industry, born of the Napoleonic wars, almost perished in the World War, being 66 per cent. destroyed. Formerly, the 213 sugar factories supplied all French consumption and 78,739 tons per year for export. Now the 60 small factories remaining can supply only a small portion of the nation's requirements, and about 400,000 tons per year are imported. One hundred and forty-two factories were 85 per cent. destroyed, and all copper coils, bronze tubing, copper and brass screens, in fact everything made of copper, bronze or brass, and all electrical equipment, was stripped out of the war-wrecked factories and taken to Germany. The plants where sugar machinery and equipment was made, suffered the same fate. The damage to sugar factories was over $89,000,000. Reconstruction in France has made enormous strides, but on account of the highly specialized machinery and equipment required, the sugar industry, has, as yet, been able to accomplish very little. Photographs of destroyed sugar factories shown.

The composition and preparation of a sugar syrup of maximum solubility: R. F. JACKSON and C. L. GILLIS. One of the large branches of the sugar industry is the manufacture of syrups for direct consumption. If the syrup consists only of sucrose, the saturated solution may contain only 38.7 per cent. of the sugar. Such a solution is too thin for a desirable product and is susceptible to fermentation. If concentrated to a denser consistency, it becomes supersaturated and deposits sugar crystals. If, however, the sucrose is partially inverted, the density may be considerably increased, but if the inversion is carried too far, the relatively low solubility of dextrose limits the density to which the syrup may be concentrated. A study was made of the mutual solubilities of the three constituent sugars, namely, sucrose, dextrose and levulose in the presence of each other. The solubility of sucrose in varying proportions of invert sugar was determined to very high concentrations of the latter. Similarly the solubility of su-

crose in the presence of dextrose ,and of dextrose in the presence of sucrose, and finally of dextrose in the presence of levulose were measured. The results of this investigation have shown the maximum concentration which invert sugar may have without depositing crystals of dextrose, and similarly the maximum concentration which a mixture of sucrose and invert sugar may have without depositing either sucrose or dextrose. The syrup which contains 29 per cent. of sucrose and 52 per cent. of invert sugar, or a content with respect to total sugar of 81 per cent., has this maximum concentration. In general, it is practicable to increase this concentration even to a slight supersaturation without danger. Such a solution is sufficiently dense for a good syrup and resists the growth of microorganisms. A number of methods of inverting sugar have been devised. We add the suggestion that the partial inversion can be accomplished by the aid of an extremely dilute hydrochloric acid and subsequent neutralization with sodium carbonate. The net result is the addition of a minute quantity of common salt. Data are provided for controlling the method. During the investigation, the densities of invert sugar solutions, the contraction of volume accompanying inversion, and the change of viscosity were determined.

Some characteristics of imported cane sugars: C. A. Browne. The general trend in the manufacture of raw cane sugar during the past decade is shown to be towards the production of 96 test sugar, which during the past 5 years has made up about 75 per cent. of the total importations. This percentage could be increased considerably if care were taken to manufacture a drier sugar that would not deteriorate. Some of the chemical, physical, mycological and entomological characteristics of the different grades of imported raw cane sugars are discussed. During the past year, considerable plantation white sugar, testing between 98 and 100, has been imported for direct consumption. Some of this sugar is of very good quality and if care were taken always to make a clean white sugar of uniform character plantation white sugar might find a considerable demand even among the more discriminating class of users.

American progress in bacteriological sugars: Edmond H. Eitel. The history of the rare sugars virtually commences with 1883. The sugars had become essential in bacteriology when in 1914 the German supply was cut off. The U. S. government found its work critically handicapped. Appeals of a patriotic nature established a rare sugar production in America. From the laboratory stage to the commercial represents a far greater achievement than is apparent. The following sugars are now manufactured commercially: l-arabinose, dulcitol, d-galactose, d-glucose, glycogen, inositol, inulin, invert sugar, lactose, d-levulose from invert sugar, d-levulose from inulin, levulose, syrupy, maltose, d-mannitol, d-mannose, melezitose, raffinose, rhamnose, sorbitol, sucrose, trehaiose and d-kylose. A greater achievement than this list, however, is the surpassing of the old standards of Kahlbaum and the discrediting of another German superman theory. The polariscope with variable sensibility, a device of American invention, and the growing knowledge of how accurately bacteria can detect minute impurities has stimulated the new standard. The use of the rare sugars in America is being extended to physic-chemistry, chemical analysis, diet, intravenous injection, plant pathology, medicine and even to experimental explosives, as well as to advances in bacteriology. A specific example of the importance of the sugars to national health and epidemiology is the differentiation possible by their means of the paratyphoid, meat poisoning and hog cholera bacilli and the resulting possible knowledge of the source of an epidemic. The solution of the problem of the sugars calls for both the chemist and bacteriologist in combination, and in the answer light will be thrown upon morphism and bacteria, configuration of sugars, the asymmetric carbon atom, theory of life and evolution.

Results of sugar cane experiments in St. Croix: Longfield Smith.

Use of kieselguhr in the clarification of cane juice: H. S. Paine and C. F. Walton, Jr. Results are reported of a comparative study of various types of kieselguhr, or diatomaceous earth, for the purpose of correlating physical properties and clarifying efficiency as a possible means of determining relative market values. The investigation of clarifying efficiency has led to a quantitative study of the colloids removed from cane juice by different methods of clarification. These experiments included a microscopic examination of the various kieselguhrs, tests of comparative rate of filtration, sedimentation, fineness by sieving, solubility in dilute acids and alkali, and the quantitative determination by dialysis of the colloids present in the juice before and after clarifi-

cation. The results so far obtained indicate that, provided a sufficient amount of kieselguhr is used to afford the minimum adsorbing surface required for the colloids present, there is little, if any, difference in clarifying efficiency when equal weights are used, even though the various kieselguhrs may differ considerably in physical properties. The dialysis experiments further proved, as has been indicated by the work of previous investigators, that heating and filtration with kieselguhr remove all colloids of such a degree of dispersion as to give a turbidity visible to the eye. Using active decolorizing carbon after preliminary treatment of the juice with kieselguhr, it was found that colloids of such dimensions as to be invisible to the eye were thereby removed.

Determination of the density of molasses: W. B. NEWKIRK. The picnometer suggested permits a greater accuracy in the determination of the density of molasses than has been possible heretofore. It is essential for commercial reasons that an accurate method of determining the density be used. The interfering obstacles in the determination of densities of molasses are due to the high viscosity, included gases and dissolved gases. The picnometer suggested is adaptable in the presence of these difficulties. It consists of a bottle fitted with an enlargement at the top ground optically flat and closed off by another optical flat. An expansion chamber is ground on to the bottle to permit the expansion of the included gas to permit of its easy removal and is fitted with a vacuum connection and stop cock in order to put the contents of the bottle under greatly reduced pressure and maintaining the same for a considerable length of time, without the loss of moisture. The evaporation is negligible. The change in temperature of the picnometer after closing is reduced by very thick walls over the neck of the flask. This reducing temperature changes on handling. Two methods of deaerating were studied—the application of heat to reduce its viscosity and the application of air to expand the entrained gas. The heating causes considerable decomposition and has a deleterious effect in the determination of the density. The vacuum method removes entrained gas and does not have the bad features of heating or dilution. The accidental errors are shown to be very small and the total error in any one direction is shown to be within .1 of 1° Brix, and the majority of determinations can be made within a few hundredths of 1° Brix. Densities with this apparatus can be determined with reasonable facility and with considerably more accuracy than the sample of molasses can be obtained.

CHARLES L. PARSONS,
Secretary

ASSOCIATION OF AMERICAN GEOGRAPHERS

THE annual meeting of the Association of American Geographers was held with the department of geography of the University of Chicago during Convocation Week. Five sessions were held at which forty-one papers were read, nine by title.

Especial interest centered in the joint meeting with the Ecological Society of America and the session devoted to invited papers on industrial geography. The papers given at the joint meeting were as follows:

Experimental animal climatology: V. E. SHELFORD.

Geography in zoological museums: A. G. RUTHVEN.

The relation of plants to new habitats: D. T. MACDOUGALL.

Ecology and geographic boundaries: H. C. COWLES.

Owing to the necessary absence of President Gregory, because of an emergency telegram, his presidential address on "Geographic basis of the political problems of the Pacific" was omitted. The following papers on Industrial Geography were given during the afternoon session of the same day.

The significance of vegetable oils in the economic development of the tropics: V. C. FINCH.

Geographical influences in marketing; illustrated by the meat industry: GUY C. SMITH.

Geographic factors in dairy farming in southern New England: RICHARD E. DODGE.

The papers presented at the remaining sessions were as follows:

Rainfall maps of Latin America: EUGENE VAN CLEEF.

The trade winds and anti-trades of Porto Rico: OLIVER L. FASSIG.

Progress in organization of the Climatological Service of the West Indies: OLIVER L. FASSIG.

Rise in temperature on mountain summits earlier than on valley floors: H. J. COX.

Cold surf with off shore winds: CHARLES F. BROOKS.

Vertical gradients of evaporation and soil moisture in desert and coastal mountains: FORREST SHREVE.

Stream and ocean terraces in relation to recent earth movements: R. S. HOLWAY.

The status of the general magnetic survey of the earth: L. A. Bauer.

A significant contrast between the Atlantic and Pacific regions: W. H. Hobbs.

Intermont basins: W. M. Davis. (By title.)

The importance and permanence of the physical factors in determining the utilization of land for agricultural and forest production: O. E. Baker.

Problems of land classification: Carl O. Sauer.

Distribution of sunlight and moonlight over the earth: Zonia Baber.

Chili: a land where immigrants need not apply: Mark Jefferson.

Some aspects of the geography of South Dakota: S. S. Visher. (By title.)

Finland as an independent republic: J. J. Sederholm. (By title.)

The Armenian frontier: Lawrence Martin. (By title.)

The geography of part of southeastern Idaho: G. R. Mansfield. (By title.)

Geographical regions of the fisheries of Asiatic Russia: S. J. Novakovsky.

The grain trade of ancient Athens: Ellen Churchill Semple.

Geography and man in Cuba: R. H. Whitbeck.

Geography and man at Panama: R. H. Whitbeck. (By title.)

Physiography and man in Porto Rica: A. K. Lobeck.

Notes on the geography of Honduras: N. A. Bengston.

A geographic study of the Saginaw Valley as an area of gentle relief: F. W. Frostic. (By title.)

Population changes in Nebraska since 1880: Esther S. Anderson.

Nashville and the central basin of Tennessee: K. C. McMurry.

The world's markets: a map based on natural regions: Eugene Van Cleef.

Significant geographic problems of the outwash plains of southern Michigan: D. H. Davis.

Census maps of the United States with some suggestions for improvement from the standpoint of geography: R. M. Brown. (By title.)

Development of productive scholarship among American geographers: W. W. Atwood. (By title.)

Bering's two expeditions to determine the relation of America to Asia: W. L. G. Joerg.

Geography as regional economics: Carl O. Sauer.

The enjoyable and stimulating sessions were supplemented by an evening dinner tendered to the association by the Geographic Society of Chicago and by an informal lunch given by the department of geography of the University of Chicago. Both these events gave an opportunity for social greeting and discussion that was much appreciated, for in the rush and demands of so large a meeting, and group of meetings, there is but little chance for social get-togethers unless they are deliberately planned for.

During the sessions the Council met and acted upon a number of important plans. W. M. Davis was appointed representative of the association in the Division of Geology and Geography of the National Research Council. He succeeds himself for a period of three years.

It was voted to hold the next annual meeting in the city of Washington during Christmas week, 1921; and to recommend to the Council of 1921 that the meeting for 1922 be held in the east and that for 1923 in the mid-west.

A canvass of the ballots showed the following officers elected for the year: *President,* Ellen Churchill Semple; *Vice-presidents,* A. J. Henry and Curtis F. Marbut; *Secretary,* Richard E. Dodge; *Treasurer,* George B. Roorbach; *Councillors,* Eliot Blackwelder, Ray H. Whitbeck, Nevin M. Fenneman.

The spring joint meeting with the American Geographical Society will be held at the society's building in New York City on April 22 and 23, 1921. Program will be published as soon as completed so that all who are interested in the papers to be given may attend. The secretary will be glad to receive the names of those who would like to be informed of meetings of the association so that they may receive programs of papers as issued.

Richard Elwood Dodge,
Secretary

Storrs, Conn.

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PLANTS AND PLANT CULTURE[1]

The enthusiasm resultant from the successful establishment of Botanical Abstracts by the combined efforts of all Americans interested in plants and plant culture has tended to revitalize the belief that a closer union of all scientific societies concerned with plants is a desideratum of great importance. In this connection the solidarity of chemistry and the consistent efforts of chemists to ally their science with industry is contrasted with the very different state of affairs that exists in botany. Another new influence of unifying tendency is the National Research Council, which, rather defying tradition, has combined in one division all of biology and agriculture. Besides it is attempting to bring about greater cooperation of research institutions and to amplify scientific activities by securing support from commercial and other sources. There still exist men who earnestly decry the economic tendencies of science and consider such argument, either as justification or for support, to be futile or dangerous. Whatever appeal there may be to botany and correlative sciences in the phrase "research for research's sake," it is Quixotic to expect it to be effective in such fields of effort as medicine, engineering and agriculture, where the relations to health, industry and prosperity are obvious.

If there is to be adopted a broader view of plant science, one that is to embrace all of conventional botany as well as plant culture, it is manifestly important that there be full discussion of the desirability of such amalgation as well as of the causes that have led to the existing state of affairs. There is apparently need of considerable readjustment of

[1] Address in the joint program of the American Society of Agronomy, Botanical Society of America and American Phytopathological Society, Chicago, December 30, 1920.

mental attitudes if the influences that have been so potent in the past are to be made nugatory.

It so happens that during the past decade or so there have been many discourses published, mostly in Science, on the general theme "What is the matter with botany?" The diverse viewpoints of experienced men have been set forth in detail, so that it is relatively easy to grasp their attitudes toward the problem. So far as I know these essays have called forth little in the way of comment from plant culturists either as expressions of sympathy or as opinions that might help in the diagnosis of the case. Now the whole matter has again come to the front, even to the extent of definite ideas to organize a broad American Plant Society that will embrace in its membership all concerned with plants or their culture. It would seem therefore that agronomists and other plant culturists can scarcely refrain longer from presenting their viewpoints as to the nature of the centrifugal forces that have kept botany and plant culture apart. Inasmuch as many botanists have attempted to define what agriculture is and what it is not, is high time that there be a rejoinder, lest silence on the part of agronomists and horticulturists be construed as assent to the statements that have been made.

A survey of the many articles by botanists in relation to the existing conditions shows that one or another of them has recognized several of the tendencies that have been more or less potent. Not unnaturally some of these tendencies or factors will be evaluated by the plant culturist quite differently from the botanist. The factors that are adduced are in part historical or traditional; in part the concomitant of intellectual isolation; and to some extent the result of conventional or even cramped ideas concerning the definition of the word science and of such phrases as pure science and applied science. Historically the development of plant culture has been almost without contact with botany or the study of plants as plants. The beginnings of plant culture go far back in the history of man, long before there were historians to record the facts or scientists to ponder over their significance. Witness the extraordinary development of maize, beans, tobacco, and other plants by the American Indian, so great indeed that the wild originals are no longer known or at least recognized as such; the marvelous series of varieties or sorghums originated by the African negroes; the endless forms of rice brought into existence by the Indo-Malayan peoples; the high development of wheat and other small grains in prehistoric times. Primitive man was indeed a wizard, agriculturally considered. Not only did he discover each and every important food plant, as well as all narcotics and stimulants, but most of them he cultivated and by one means or another developed numerous varieties. From prehistoric man we inherit not alone a wealth of crop varieties but more or less definite knowledge of cultural methods. From this foundation modern plant culture has been developed by farmers, gardeners, agronomists and horticulturists by an almost infinite amount of "cut and try." Practically all of the progress in tillage, manuring, drainage, irrigation, breeding, pruning, has thus been obtained.

It may be that underlying the historical relations or lack of relations between botany and plant culture is what one botanist refers to as "intellectual isolation," "provincialism," and as a "feeling of superiority." Perhaps the wit's definition of a professor of botany carries the same import as does the phrase "intellectual isolation." "A professor of botany is a man who teaches what he knows about plants to young men and women who expect to instruct students who desire to become professors of botany to train others to teach." This definition suggests what the doctors call a vicious circle rather than the society ideal called a "select circle."

Inasmuch as a prominent botanist used all of the quoted expressions, it may be permissible to divulge an open secret among agronomists and horticulturists, namely, that the last one especially, the "feeling of superiority," has long been recognized as an important element in preventing more cordial

relations between conventional botanists and plant culturists. In the recent articles that I have referred to, several of the writers contrast such subjects as agronomy, horticulture, forestry, with botany, manifestly implying that the former are no part of botany. The omission of the mention of any branch of plant culture in other articles would also justify the deduction that they are excluded subjects. On the other hand a few botanical writers point out that it is the great weakness of conventional botany that it has held aloof from the culture of plants as a proper field of its activity; deplore the fact that botany has been restricted mainly to impractical considerations and that the practical uses of plants have largely been segregated in other fields of endeavor. Curiously enough, botany has always displayed a more cordial attitude toward pharmacy and forestry than it has towards horticulture or agronomy. Perhaps drugs and trees smack less of the farm than do soils, manures, and crops. It may be related to that curious human tendency, especially of the city dweller, to expend wit on the tiller of the soil; a peculiar mental trait that has given a sinister or derogatory meaning to such originally innocent terms as villain, heathen and pagan.

Whatever the causes may have been, it has come about that botanists get a very different training from agronomists and horticulturists. It is a trite saying that botanists know nothing about plant culture and agronomists and horticulturists little about botany. Individuals fairly proficient in both are all too scarce. We are thus perpetuating in our schools the schism that exists between the two groups of men who devote their energies to problems concerning plants. It is comforting to believe that more and more of us are coming to realize that this is truly deplorable. I can well appreciate a consuming interest in plants solely on account of the wonderous diversity of their forms: of the extremely interesting phenomena in their growth and movements; of their complex relations to each other and to their physical environment; of the intricacies of their cellular structures and functions; but the practical world is more interested in plants as sources of food, raiment and other necessities. While it is perfectly true that mankind can not live by bread alone, it is equally true that if he does not provide for bread he will very soon be freed from all other cares and desires.

This separation of botany from plant culture is, as already pointed out, tacitly admitted in numerous recent articles. It is likewise evident enough in text-books. In Pfeffer's "Physiology of Plants," for example, whenever the subject-matter impinges on plant culture, the student is referred to Mayer or some other agricultural text. It is related of a famous German botanist that when a student asked the name of a particular cultivated plant, he replied: "How should I know? Ask the gardener." Perhaps some of the inexcusable misidentifications of plants in recent technical articles were due to asking the gardener. Some exceptions to this narrow attitude conspicuous on account of their rarity do indeed occur among botanists where men were interested in the relation of their discoveries to plant culture. I refer to such men as Gaertner, Sachs, Miller, Don, as a few examples.

Again, there are some current ideas concerning the nature of science and its conventional divisions, pure science and applied science, that need to be dispelled and if possible corrected.

Some of my botanical friends would at once protest at the title of my address, and suggest that it would better be "Plant science and plant culture," arguing in this wise: plant science or botany is the whole knowledge of plants that has been accumulated and is systematized and formulated in respect to all the general principles that have been discovered; whereas plant culture is purely an art, to a large extent the result of the application of botanical principles. As printed evidence I quote from one of the botanical writers:

> Agriculture, for example, is not a science, but an art, and whatever of science it employs is ap-

plied from botany, zoology, geology, climatology and so forth.

The implication conveyed in designating plant culture as an art is presumably that a science is something intellectually higher. Of course, this is a mere matter of definition of terms. Someone has proposed the definition: Science is "finding out and learning how and why." So broadminded a man as Huxley once gave his views of science as follows:

> To my mind, whatever doctrine professes to be the result of the application of the accepted rules of inductive and deductive logic to its subject-matter: and which accepts, within the limits which it sets itself, the supremacy of reason, is science.

There is in this definition no trace of restriction as to what the subject-matter may be. It pertains quite as much to plant culture as to plant morphology, to goats as well as sheep. A restricted definition that classifies knowledge of plants as science and disposes of knowledge of plant culture as non-science, has not been a solidifying influence among plant workers.

The attempts to divide science on the basis of quality or usefulness have been in the main very unfortunate as in most cases one of the subsidiary terms involves a disparagement; thus pure science and applied (by implication impure) science; fundamental and superficial; practical and theoretical (by suggestion impractical) science; philosophical and practical science. Some of the terms suggest that they were invented by snobbish persons, but others seem sincere efforts to distinguish purely pragmatic knowledge from that which rests on a philosophical or theoretical basis. It would make for greater solidarity, I imagine, if instead of making distinctions that concern persons as well as things, we should emphasize "science in the service of humanity" or "science the handmaid of progress."

If we must persist in the attempt to distinguish two sorts of science I would suggest empirical and philosophical. The former would include in the main information based purely on observation or on test, as long as the underlying causes are unknown or vague, and which some writers delight to call "mere empiricism"; the latter to the knowledge which is illuminated by proven theory or broad inductive generalizations. I suspect it is the mental satisfaction derived from knowing something of the why and the how that tends to make us regard philosophical science as something more to be esteemed than is information of facts regarding the underlying causes of which we are either entirely in the dark or guess at vaguely. It is much as though we praised ourselves unduly when we solved wholly or in part one of nature's puzzles, and called the other fellow stupid because he could not unfold his problem. It is perhaps well to be modest and to realize that some riddles are much more difficult than others.

But the phrases "pure science" and "applied science" have involved other unfortunate consequences even to the confusion of thought. "Applied science" is conceived by some writers to imply the employment of definite known scientific truths or principles. In the words of one writer, "You must have your science before you can apply it." If this statement be true, there is very little of applied science in plant culture, or indeed in all agriculture. It is safe to say that 90 per cent. of what is known of practical methods in the culture of plants is almost purely empirical, and has been gained by an enormous amount of observation in actual trials. This information is nevertheless real knowledge as measured by the best of standards; it works in practise, however little we may know about the underlying causes or factors. The repeated assertions to the effect that the major part of agriculture is something applied from botany, chemistry, geology and what not is one that I wish emphatically to contradict. I have no hesitancy in stating that 90 per cent. of the garnered knowledge of botany in the traditional sense has no obvious relation to plant culture, and most of it has little conceivable relation. Another writer asserts,

> It is the pure or fundamental science that keeps applied science alive, that makes progress possible.

An obvious rejoinder is that is is the applied science that keeps the investigator alive. So far as plant culture is concerned, it existed thousands of years before there were such a thing as pure or fundamental science, unless I mistake what is meant by this phrase. Clearly the quotation asserts too much, if plant culture is part of "applied science."

The statement that plant culture is made up largely of botany is objectionable, first of all because it is offensively patronizing and second because it is to a great extent not true. The plant culturist, be he agronomist, horticulturist, forester, or what not, is concerned first of all in the methods that make for the successful culture of a plant, and secondarily in the factors or factor complexes that affect quantity or quality of yield. Yield, including the underlying factors, is the central consideration in plant culture, but the word yield is seldom seen in a botanical text-book. In the culture of crops there are four major series of factors that affect yield, namely, the adaptations of the plant, the quality of the soil, the climatic factors, the cultural or artificial factors. It is a fair assumption that if the best adapted variety be planted on rich soil and intelligently cultivated the highest yields are to be expected if the weather condition are favorable and pest injury reduced to a minimum. It is worth while considering briefly just how much we know concerning the relation of yield to a few of the factor complexes mentioned.

Consider first the plant and its habits, or if you prefer its ecological adaptations. Undoubtedly primitive man, like the modern grower of orchids, attempted when he first cultivated a plant to imitate its natural habitat. He certainly did not plant rice on the dry hilltops nor wheat in the marshes. But what after all do we know about these habital adaptations save by observation. No sensible man would expect to succeed with bananas outdoors in New England. But just why is it, if you please, that bananas can not stand as much cold as apple trees? Or consider a simpler case, namely winter wheat and spring wheat, perhaps representing the broadest extremes in a single species of physiological adaptation in relation to temperature that has been developed in plant culture. Just why does the one endure much lower temperatures than the other? It would seem practically certain that the differences are not due to any morphological character, since similar phenomena occur in naked organisms; therefore, it is nearly certain the differences in adaptation lie in the protoplasm. But it must be admitted we have not even a working hypothesis as to the nature of the machinery.

Again consider the behavior of some introduced plants with that of others brought from the same region. Bluegrass, redtop and white clover have spread over all of the northeastern fourth of the United States and tend quickly to occupy all cleared and untilled land; in other words, they spread aggressively. In contrast, certain other common European grasses can barely exist or do not thrive at all. Crested dog's-tail is rather a botanical rarity in the United States notwithstanding that thousands of pounds of seed are sown annually, just because the English consider it a good grass. Still more remarkable is *Weingartneria canescens,* a grass the viable seed of which is an abundant impurity in certain European seeds, but no one has ever found a specimen of the plant in the United States. Japan clover, introduced accidentally about 1853, has spread over all the south. The lowland ranges of California are covered with grasses and other herbs, 80 per cent. of the bulk of which is made up of Mediterranean plants. On the foothills of the Himalayas the Mexican dahlia escaped cultivation and now covers miles of the mountain sides. In Ceylon and Java an extremely aggressive and abundant sunflower-like plant is *Tithonia diversifolia,* which in its native home near Acapulco, Mexico, is a very restricted rather rare plant. Many other cases might be cited. Why are some of these introduced plants so aggressive and others so impotent? It is an evident fact and a clear problem of much importance agriculturally. All that we can postulate is that as a rule an introduced plant that is aggressive comes from a region

with closely similar climatic conditions. Rarely a native plant shows similar aggressiveness like ragweed in the north and *Eupatorium capillifolium* in the south. Various hypotheses have been advanced to explain the aggressiveness of weeds, but they are simply hypotheses. Certainly attempts to find a correlation between weediness and abundance of seeds produced has proved a dismal failure. Nor has any better success been achieved toward understanding the contrasting phenomenon of dwindling or "petering-out."

The distribution of the species of a genus —let us say the oaks of the United States—is an interesting phenomenon. But why is one species circumscribed thus and another delimited so? To say the species have different adaptations is merely stating the fact in other words. If we are honest, we must admit, I think, our complete ignorance. Now these are samples of a great group of phenomena that confront students of cultivated plants. They must very properly, I think, also be considered problems of ecological botany. But the ecology of the botanists has not thus far developed enough to be an asset to the plant culturist. The details of pond margins, mountain tops, and seashore strand throw no light on why maize or potatoes or wheat thrive better in some situations than in others.

Now we come to soils. Surely chemical and botanical science have here rendered signal service to plant culture. Here again it is well to consider primitive plant culture. Undoubtedly our prehistoric ancestors must have observed the greater luxuriance of plants on certain soils, about dung droppings and on landslides. Certain it is that long ago many uncultured tribes had learned to use dung, ashes, fish, leaf mold, seaweeds, and other substances to increase yields. One of the early results achieved by chemists and botanists was to determine the chemical elements necessary to plant life. Eventually from this developed the idea that all of these necessary elements were amply abundant everywhere except nitrogen, phosphorus and potash. And very naturally substances containing these elements were sought out to use as fertilizers. The history of the development leading up to the conclusion stated and its general adoption, was by no means simple. On the agricultural side the great exponent was Liebig. But one can not to-day read Liebig's numerous works without realizing how much he floundered in the maze of conflicting facts and theories and the many errors into which he was led. In his combatting of the old humus theory of plant nutrition he denied any value whatever to humus except to supply carbon dioxide, but in spite of his teachings the German farmers refused to abandon the use of dung and compost. Liebig also clung to the idea that nitrogen was of no avail as a fertilizer, as the atmosphere furnished abundant supply. One of the controversies over nitrogen was finally solved by Helriegel and Wilfarth, who established the fact that legumes by the aid of root nodules were able to utilize atmospheric nitrogen. This is one of the striking landmarks of agricultural science, but it is well to remember that the practical effect of legumes in rotation was well known to the Romans and other ancient peoples. In Hartes "Husbandry," published in 1764, is written:

> All plants that bear leguminous flowers (as lucerne, sacrifoin, trefoils, vetches, etc.) enrich the ground and of this the husbandman has daily experience in the culture of clover.

In its final evolution the Liebig theory of soil fertility came to mean that the productivity of a soil was primarily determined by the quantity and availability of the nitrogen, phosphorus and potash which it contained. Indeed many modern writers identified these three substances as *fertility.*

Curiously enough, almost any experienced farmer will express an opinion after examination as to the quality of a soil. His standards of measurements are about as follows: Soils decrease in productivity based on correlation with texture in about this sequence—clay loams, loams, silt loams, clays, fine sands, coarse sands, gravel; and in color in about this order—black, brown, red, yellow, gray, white. His judgment is therefore based in part on texture and in part on color. Crude

as this basis of measurement may be, it certainly has some correlation with productivity. Indeed it may be said that chemical methods of soil examination resulted in a great neglect of the study of the more obvious characteristics. Unquestionably the best index of the quality of a soil is its productivity in crops. Analyses of soil from good spots and from poor spots in the same field have sometimes revealed no differences. This fact and others led to the concept that productivity might be lessened not only by the absence of a necessary element but the presence of a deleterious agent, and that fertilizers were in some cases at least substances that inhabited the injurious factor. It is a long story to consider this subject, but viewed purely as a theory it can explain some things not clarified by the plant food theory. It is well to remember that many investigators who considered the effects of nitrogen, phosphorus and potash as due solely to additional plant food, nevertheless regarded the effects of lime as partly at least due to overcoming an unfavorable factor, and the action of still other materials as stimulants, without clearly defining what they meant by stimulants. The available facts were simply the addition of the substance and the end reaction of the plant. The different rôles postulated are in the main hypotheses, and the existing body of facts certainly is insufficient to prove any one of the simple theories. A broader view now coming to be widely held is that the soil is a complex of very numerous factors, good, bad, or indifferent so far as a particular plant is concerned, and the end result measured in yield is the balance of the conflicting factors. To state it in another way productivity is probably quite as much influenced by qualititative soil differences as by quantitative diversities—but the theory that has generally been accepted is purely quantitative. Such a view of "soil fertility" which it must be admitted can now be measured only in terms of yield, means that it is comparable in scope to "weather" as applied to the seasonal complex of climatic factors. The actual knowledge that we have of soil productivity and of fertilizers is therefore still almost wholly empirical. The extension and clarification of this knowledge is, it seems, most likely to be obtained by a much more intimate knowledge of the plant reactions to each of the soil factors that can be controlled and the different combinations of these factors. An exceedingly interesting recent contribution is that of Bottomley, who presents strong experimental evidence to show that highly organized green plants must have dead organic matter as part of their food.

The effects of one crop upon another often very marked, sometimes beneficial, more often injurious. The nature of these effects is very obscure, but it now seems clear that it can not be wholly related to the quantitative supply of plant food. These phenomena have been used to lend support to the theory that yields are often greatly reduced by the presence of deleterious substances, in this case supposed to be excreted by the preceding crop. The theory is attractive in its simplicity and there is some evidence in its favor, but there is no clear proof that plants do excrete repellant substances. The curious way in which certain wild plants occupy areas to the complete or nearly complete exclusion of other species might well be due to such a factor. The effect of one plant upon another is an old observation in plant culture, and appears in botanical literature as early as Von Mohl. It is only in recent years that the actuality of the fact is established beyond doubt. An understanding of its basic causes is manifestly a matter of great importance. At the Rhode Island Experiment Stations, onions varied in yield from 13 bushels to 412 bushels per acre in a long series of plots, the differences being due solely to the effects of the preceding crops.

The subject of tillage is likewise one much involved. The simplest plant culture requires some disturbance of the soil, even if only to remove stones or roots. But different methods or different degrees of stirring the soil, show marked effects on subsequent yields. So great are these differences that the famous Jethro Tull proclaimed the slogan "Tillage is

manure," meaning that the same end results could thus be obtained. Why? There is a bewildering array of hypotheses as to why tillage tends to increase yields, including better mechanical conditions; improved aeration; increased nitrification; additional carbon dioxide; mixing of the soil; elimination of weeds; and in dry regions particularly conservation of moisture. There may be and probably is some truth in all of these explanations but exact data on any of them are far from abundant. The really definite knowledge is empirical, namely, that tillage methods do tend to increase yields.

The breeding of plants has been a most potent factor in securing larger and better yields. Our knowledge of genetic phenomena has been enormously increased in recent years from the activity incited by the rediscovery of Mendel's law. The effect of this greatly increased knowledge of genetics has inspired many immoderate statements as to its effect on agriculture. Thus one writer says " Through scientific work in the study of heredity, we have learned to multiply the races of our useful plants so that they may fit in more exactly to the variable conditions in which plants must be grown," and that Mendel's law " is the basis of most of our work in the study of heredity and this in turn has made agriculture scientific." It is pleasing to learn that a bit of leaven like this is able to uplift all agriculture into the condition called scientific, while presumably it was before something different. As a matter of fact, the practical value of Mendelian knowledge to plant breeding is disappointingly small. Witness the innumerable improved varieties in all our cultivated plants long antedating Mendel. Consider the lilies, the roses, the chrysanthemums, the carnations, the tulips, indeed, any plant much cultivated, and ponder upon the infinite amount of work that led to their development—all without the guidance of any scientific theory. This admission does not discount the tremendous value of the new knowledge of genetics which gives us so great an insight into the factors involved in plant variations.

The nature of plant diseases and the methods discovered for their control is a contribution to plant culture for which the botanists of the schools may rightly claim large credit. This is clear in spite of the fact that farmers and gardeners had before the day of plant pathologists found out the efficacy of bluestone for wheat smut and sulphur for mildew; and against other diseases had developed resistant or immune varieties. The development of phytopathology is an index, I believe, of what might well happen in other fields of plant culture, if trained botanical workers will wholeheartedly engage in its problems and avoid being attracted more to the purely scientific problems than to those of cultural import.

The climatic complex of factors is difficult to evaluate. Numerous attempts have been made to correlate growth and yield with the curves of temperature and of moisture precipitation and even specifically to outline the limits of the future extension of wheat culture northward. Thus far these attempts have not thrown any great light on the problems of climatic adaptations.

I must not omit, however, the recent illuminating contribution of Garner and Allard, who have discovered the remarkable reactions of plants to the length of daily illumination. Any one who has cultivated plants has come to realize the extraordinary way in which they behave under different conditions, one might say the vagaries which they exhibit. One of these is the manner in which most plants speed up their maturing in fall. The farmer says the plant is hurrying to get ripe before frost. Several vague theories were current among plant culturists as to the cause of this phenomenon, one that the stimulating factor was the increasing difference between day and night temperatures, another that it was due to the increased temperature of the soil. It is remarkable to how high a degree the temperature factor was assumed in every periodic phenomenon. Garner and Allard have accumulated a mass of experimental data that leave no room for doubt that the stimulating factor is associated with the daily length of

illumination. Indeed it may be hazarded that it is this stimulus which normally controls all recurrent periodic phenomena in plants and animals. Just how it is to be correlated with certain other phenomena which form the basis of Kleb's salts-carbohydrate theory is not yet clear. It is quite possible that entirely different stimuli affect the control of vegetative and reproductive phenomena so as to give similar end reactions. The Garner-Allard factor certainly provides a new method of approach to study the internal factors that control the plant's activities. It is probably not a wild guess that these internal factors are as numerous as the genetic factors concerned in the plant's heredity mechanism. As it happens, the approach to this problem and the progress made in its solution was purely from the agronomic viewpoint and with the object of solving an agronomic puzzle. This is worthy of mention as an illustration of the fact that the plant culturist gets a different contract with plant phenomena from the botanist of the laboratory.

The plant culturist has long been familiar with the phenomena illuminated by Garner and Allard. It is this factor which in the case of field crops led to date of seeding trials —by which in a purely empirical way the best date of seeding or planting for each locality was determined. Any one who has seen plots of millet, for example, planted at succeeding dates will appreciate how much this factor alone can affect yields.

Another important factor affecting yield is the spacing of the plants whether secured by rate of seeding or by planting at measured distances. It is easy to understand why too sparse seeding will reduce yields and also to comprehend that crowding may result unfavorably—but it is doubtful if any other method than actual trials will ever enable us to ascertain the optimum rate of spacing for any particular crop at any specific place. Curiously enough as Mooers has shown, varieties of maize not markedly unlike have very different optima as regards spacing. In southern India where rice culture is very ancient, and the seedlings are transplanted by hand, Wood was able to increase yields materially by determining the optimum spacing distance. Incidentally this greatly reduced the amount of seed necessary which in a country where the daily wage is eight cents was a considerable economic factor. Such empirical data as these are highly important in plant culture—and it seems not unlikely that they always will have to be determined by test and not by some mathematical equation.

In America, crops are mostly planted as pure culture, in India usually as mixed cultures, one of the plants commonly a legume. Mixed cultures usually outyield pure cultures —but except where the crops are garnered by hand, the increased cost of harvesting becomes an important economic factor. Why mixed cultures, even of the small grains, outyield pure cultures is an interesting phenomenon, and one can easily theorize to his heart's content. In nature plants are usually, but not always, in mixed cultures. Actually we know practically nothing of these phenomena except the observed or experimental facts.

Perhaps no one will contend that a graduate of the best botanical courses in America is thereby fitted to undertake the cultivation of any crop, let alone such as require special knowledge and skill. It is remarkable to how great a degree that success in growing a crop is based on the slowly accumulated results of experience. During the war you will remember there was urgent need for a large supply of castor beans. It is doubtful if in the whole history of American agriculture there was ever a more dismal failure than the attempt to produce these beans. There was an abundance of theoretical data based on the culture in other countries, but in attempting to grow the crop in the United States the handicaps of unadapted varieties and unexpected difficulties proved disastrous. Perhaps in no other industry is the advice "Make haste slowly" more applicable than in agriculture.

I have endeavored to point out by a few examples of plant cultural problems how different they are from those considered in the conventional botany of the schools. The

methods of research developed in the laboratories hardly apply at all to the problems of plant culturist, a fact that the laboratory men have scarcely appreciated, and which has led them into a mental attitude disparaging toward the methods of the agronomist and horticulturist. It is not insignificant that the discoveries of Mendel, of Helriegel and Wilfarth. of Garner and Allard were made possible by problems revealed in the culture of plants and all were solved by the simplest of methods. Koelreuter's work in hybridization was largely inspired by his knowledge of garden plants, and was promptly utilized by horticulturists though ignored by botanists. One may well doubt whether laboratory botanists could ever have detected the meaning of the dance of the chromosomes; though I am not unaware that there were dim guesses as to what they might signify even before the revelations of modern Mendelism.

One of the phrases too often seen in print is "revolution in agriculture." The expression is almost purely rhetorical and not a statement of fact or even of approximation. In most cases large changes in agriculture have been due to very simple things, usually the introduction of a new crop or the sudden expansion of an old one. Witness alfalfa in the west, sorghums in the southwest, rubber in Malaya, the sugar beet in Europe, the increase of cotton in the south following the invention of the cotton gin. I can recall nothing of comparable effect on agriculture resultant from a discovery in a botanical laboratory. It may be argued, truly enough, that the knowledge of bacteria has revolutionized modern medicine; but the credit for this advance can scarcely be claimed by botanists. Botany seems truly to have neglected its splendid opportunities in its adherence to the fetich of pure science.

It may be well to caution that in any attempt to unify botany and plant culture, the word botany will exercise no hypnotic influence. Rightly or wrongly the word does not convey to the public mind something highly desirable and useful. To the ordinary man a botanist is a more or less queer individual who goes about with a tin box over his shoulder collecting plants. Perhaps this had something to do with the loss of caste of taxonomy among botanists. It may be questioned, however, if the whittling of paraffine sections, or the use of strange apparatus in the woods and marshes, or the growing of fungi in test tubes will lead to a profoundly different evaluation of botany.

I trust that any frankness of expression that I have indulged in will not be interpreted as ill-will, but that it will be regarded as an effort to clear away the mist and to bring about better understanding. Much that has been written on the general subject seems to carry the impression that plant culturists have a stolidity that partakes of the ox, and do not wince at the reflections that come from the pens of botanists. It may be well to dispel any such assumption, which in my judgment has done incalculable harm to botany.

The points of my thesis are virtually three: (1) that our knowledge of plant culture is to a very large extent still almost purely empirical; (2) that there has been a lamentable tendency to consider plant culture and its methods of study as something apart from botany and not worthy of so high respect; and (3) that there has been proneness to claim for botany as well as for chemistry an undue amount of merit for what they have contributed to agriculture.

I have, I believe, as much faith as any one in the services that plant science can render to mankind, and that not by furnishing bread alone. There is need, however, of broadening our vision and ideals, of freeing ourselves from any caste feeling, of recognizing that the human race is at least as much interested in food and food production as it is in the fate of the synergids, the origin of the angiosperms, or the genes of *Capsella*. For the good of all of us there is every reason to bring about a closer union of the societies interested in plants and their culture. Such a union will without doubt lead to better mutual understanding and reciprocal sympathy. At least we shall learn that most conventional botanists as well as plant culturists are, after all, to

use the expressive slang of the day, "regular fellows."

The last few years have taught us all how small a reserve of food there is even in normal times. Largely as a result of the cataclysmic war famine now stalks over much of the earth. It needs no Malthus to convince us that an adequate food supply will become more and more the great problem of mankind. In spite of the haziness that envelops most of our present theories of productivity, one can scarcely fail to have faith that it is the half light that precedes dawn. The complex and obscure factors involved in crop production need for their solution a far greater number of botanically trained investigators. With clearer theoretical understanding of these factors, there is every reason to believe that the earth will be made to yield more abundantly. It is to this field of investigation so vital to human welfare, that I confidently hope botanists will more and more devote their energies, both as a matter of duty to mankind, and as an earnest of faith in their science and the services it can render.

Charles V. Piper

SCIENTIFIC EVENTS

THE CARNEGIE TRUST FOR SCOTTISH UNIVERSITIES

The *British Medical Journal* states that the annual meeting of the Carnegie Trust for the Universities of Scotland was held in a committee-room of the House of Lords, on February 9, with Lord Balfour of Burleigh in the chair. Lord Balfour said that the principal event of last year was the allocation of grants for the quinquennial period of 1920–25. In addition to the £200,000 from income, it had been resolved to allocate from the reserve fund £49,000. The explanation of this was that during the war the students at the universities were fewer, and therefore the trustees saved on the payment of fees. It would have been absurd to save that money and put it to the reserve, when many of the same students were coming back after the war and wanted it. The trustees thought it right, as a temporary measure, to take it out of the reserve fund, and give it to them to pay their fees. Under the research scheme it had been agreed that as an experiment for a period of three years the following annual grants be offered to the universities to be spent in payment of half the salaries of persons engaged as part-time assistants or lecturers on condition that they devoted not less than half their time to research, and that the universities should contribute the other half of the salaries from other sources—Glasgow and Edinburgh £1,000 each, St. Andrews and Aberdeen £800 each. It was hoped that much good to the universities would result from this combination of teaching and research, and the scheme had been well received by the universities. Although the amount available for assistance to students was now fully £60,000, there was a deficit of £8,538 for 1919–20. The universities were now increasing their tuition fees, and as a result the poor student would be poorer than ever. Thus the difficulties were very great. For many years the trustees had been able to pay all eligible applicants the whole of their class fees, but in 1911–12 they had had to have an allowance system, because the income would not cover the whole of the fee, and since then the trustees had been paying only a part of the fees. The situation would be further changed in the current year owing to the increase in tuition fees.

The discussion in which Lord Haldane, Lord Sands, and others took part, centered chiefly in the problem of allocating assistance to the students. It was agreed that steps must be taken to eliminate from the beneficiaries of the fund those applicants whose circumstances were such as to render assistance unnecessary. Proposals were made for strengthening the declaration made by applicants and for an inquiry into individual circumstances. The suggestions were discussed, but a decision will not be reached until the alternatives have been further considered in the light of the views expressed by university authorities and others interested.

MEETING OF THE ORGANIZING COMMITTEES OF THE SECTIONS OF THE BRITISH ASSOCIATION

Nature states that a combined meeting of organizing committees of the Sections of the British Association was held at Burlington House, on February 25. The meeting was called to consider various suggestions as to number and grouping of sections, presidential addresses, and other subjects discussed in the recent correspondence in *Nature* and elsewhere, and also to facilitate the arrangement of joint programs between two or more sections for the annual assembly at Edinburgh in September next. At the general session it was agreed that the number of sections should not be reduced, but that voluntary grouping for the consideration of subjects of common interest was desirable. The council (through the general officers) was empowered to fix hours of addresses and discussions, and the view was approved that the oral delivery of presidential addresses should be optional, as well as that the addresses themselves might be used to open discussions. It was also decided that the council should invite the recorders of sections, or their nominees, to be present at meetings of council when presidents of sections are elected. Organizing committees will thus, through their representatives, be able to put forward their views as to new sectional presidents. Several joint discussions were arranged for the forthcoming Edinburgh meeting, among them being one between the Sections of Physics and Chemistry on Dr. Langmuir's theory of the atom, and another between the Sections of Economics, Education, and Psychology on vocational education and psychological tests.

THE PERSONNEL RESEARCH FEDERATION

Under the auspices of the National Research Council and the Engineering Foundation, in the building of the National Research Council, Washington, the organization of the Personnel Research Federation was effected on March 15. This federation includes in its membership scientific, engineering, labor, management and educational bodies. It has been organized to bring about interchange of research information among the organizations which are engaged in personal research. It is reported to the new federation by the Bureau of Labor Statistics that there are 250 such organizations in the United States. The Personnel Research Federation will collect research information, will encourage research through individuals and organizations and will coordinate research activities.

Temporary officers were elected as follows:

Chairman: Robert M. Yerkes, representing the National Research Council.

Vice-chairman: Samuel Gompers, representing the American Federation of Labor.

Treasurer: Robert W. Bruere, representing the Bureau of Industrial Research.

Secretary: Alfred D. Flinn, representing the Engineering Foundation.

Acting Director: Beardsley Ruml, assistant to the president of Carnegie Corporaton of New York.

The aims of the new organization are increased efficiency of all the personnel elements of industry—employer, manager, worker—and improved safety, health, comfort and relationships.

The immediate purposes of the Personnel Research Federation will be to learn what organizations are studying one or more problems relating to personnel and the scope of their endeavors, and to determine whether these endeavors can be harmonized, duplication minimized, neglected phases of the problems considered and advanced work undertaken.

On November 12, 1920, a preliminary conference was held in Washington under the auspices of the National Research Council and the Engineering Foundation, attended by forty persons, including representatives of national organizations of scientists, engineers, labor, capital, managers, educators, economists and sociologists. The question under discussion was the practicability of bringing about cooperation among the many bodies conducting research relating to men and women in industry and commerce, from management to unskilled labor. Such topics as the relations of persons doing different parts of the

work, and the influence of working conditions upon the health, output and happiness of the workers, are examples of those which could be made subjects of research. The underlying ideas which led to the conference, were (1) the advantages of studying such questions by the scientific method of gathering facts and using them to reach conclusions instead of discussing opinions and propaganda, and (2) the need for cooperation among the organizations and individuals engaged in such studies.

GRANTS FOR RESEARCH MADE BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AT the Chicago meeting of the association, the Committee on Grants distributed five thousand dollars for the year 1921 in different sciences as follows:

MATHEMATICS

One hundred and fifty dollars to Professor Solomon Lefschetz, of Kansas University, in support of his work in algebraic geometry.

PHYSICS

One hundred and fifty dollars to Professor W. F. G. Swann, of the University of Minnesota, for the investigation of atmospheric electric phenomena in the upper air.

Two hundred and fifty dollars to Professor H. M. Randall, of the University of Michigan, in support of his work on the infra-red rotational absorption spectra of gases.

Two hundred dollars to Professor Walter G. Cady, Wesleyan University, Middletown, Connecticut, in support of his work on electrical reactions produced by piezo-electric crystals in high frequency circuits, and the internal viscosity of elastic solids.

One hundred dollars to Professor Paul F. Gaehr, of Wells College, for his study on the specific heat of tungsten at incandescent temperatures.

One hundred dollars to Professor Arthur L. Foley, of Indiana University, in continuation of a previous grant for his experiments on the speed of sound close to the source.

CHEMISTRY

Two hundred dollars to Dr. Gerald L. Wendt, Unversity of Chicago, for investigations at high temperatures.

Two hundred dollars to Professor Graham Edgar, of the University of Virginia, for the purchase of a quartz mercury arc lamp for research in photo-chemistry.

ASTRONOMY

Two hundred dollars to Dr. Sebastian Albrecht, of Dudley Observatory, Albany, New York, in support of his investigation of the variation of wave-length of lines in different types of stellar spectra.

Two hundred dollars to Miss Caroline E. Furness, Vassar College Observatory, for assistance in the measurement and reduction of photographic plates.

GEOLOGY

Three hundred dollars to Mr. Frank B. Taylor, Fort Wayne, Indiana, as a second grant in support of his field studies on the stages of the last glacier as it retreated down the St. Lawrence Valley.

Two hundred dollars to the Seismological Society of America, to replenish the fund at their disposal for the immediate investigation of earthquakes by sending a competent observer to the place of occurrence before much of the evidence has been obliterated.

ZOOLOGY

Two hundred dollars to Dr. P. W. Whiting, of St. Stephens College, in addition to previous grants in support of his study of genetics in insects.

Four hundred and fifty dollars to Dr. N. A. Cobb, of the United States Department of Agriculture, for aid in a series of researches into the physiology of the cell; also to defray cost of publication of results already on hand.

BOTANY

Three hundred dollars to Professor George B. Rigg, of the University of Washington, for work on the sphagnum bogs of the Puget Sound region.

Five hundred dollars to Professor J. M. Greenman, Missouri Botanical Garden, toward the completion of his work on the Senecio and related genera.

PSYCHOLOGY

One hundred and fifty dollars to Professor T. R. Garth, of the University of Texas, for a psychological study of Indiana children in the United States Indian Schools at Chilocco, Oklahoma, and Albuquerque, New Mexico.

One hundred and fifty dollars to Professor E. G. Boring, Clark University, for the preparation of

a set of steel acoustic cylinders to be used in determining the nature of sensory response under conditions of normal psychometric situation.

ANTHROPOLOGY

Two hundred dollars to Professor A. L. Kroeber, of the University of California, for bibliographical and clerical assistance in connection with an ethnological investigation to determine the culture areas of aboriginal South America.

One hundred and fifty dollars to Miss Helen H. Roberts, of the American Museum of Natural History, for a study of negro folk-music in Jamaica.

PHYSIOLOGY AND MEDICINE

One hundred and fifty dollars to Professor Carl J. Wiggers, Western Reserve University, in continued support of his investigation on the physiology of the circulation.

One hundred and fifty dollars to Professor Frank A. Hartman, University of Buffalo, for aid in the study of suprarenal insufficiency, including circulatory, respiratory, temperature, and fatigue changes, as well as possible histological alterations in the ductless glands.

Two hundred dollars to Professor W. E. Garrey, Tulane University, for the purchase of apparatus for hydrogen ion determination.

One hundred and fifty dollars to Professor F. P. Knowlton, Syracuse University, in support of a study of the blood flow and gaseous metabolism in the thyroid gland.

JOEL STEBBINS,
Secretary Committee on Grants

URBANA, ILLINOIS

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM CROCKER, associate professor of botany in the University of Chicago, has been appointed director of the newly founded Thompson Institute for Plant Research at Yonkers, New York. He will enter on his work next autumn. The board of trustees of the new foundation will consist of three business men and three scientific men. Professor John M. Coulter, head of the department of botany at the University of Chicago, and Raymond F. Bacon, of the Mellon Institute of Pittsburgh, will be two of the scientific men, and these two will select the third.

THE nomination made by ex-President Wilson, not confirmed by the Senate before adjournment, of Rear-Admiral E. R. Stitt to the position of Surgeon-General of the Navy, succeeding Rear-Admiral Braisted, retired, has been sent again to the Senate by President Harding.

HONORARY membership in the Chemists' Club of New York City was conferred upon four American and four foreign chemists at the dinner commemorating the tenth anniversary of the opening of its present home at 52 East Forty-first Street. The foreign chemists were Dr. Giacomo Giamician, professor of general chemistry at the University of Bologna, Italy; Dr. Henri Louis Le Chatelier, professor at the Collège de France and at L'École des Mines; Dr. Ernest Solvay, of Brussels, Belgium, founder of the ammonia-soda process, and Sir Edward Thorpe, professor of chemistry emeritus of the Imperial College of Science and Technology, South Kensington, England. The Americans were Dr. John Uri Lloyd, of Cincinnati, former president of the American Pharmaceutical Association; Dr. William Henry Nichols, of New York, former president of the American Chemical Society, the Society of Chemical Industry and the Eighth International Congress of Applied Chemistry; Dr. Edgar Fahs Smith, of Philadelphia, President of the American Chemical Society and until recently provost of the University of Pennsylvania, and Dr. Edward Weston of Newark, N. J.

DR. FRANK WIGGLESWORTH CLARK and Dr. H. S. Washington have been elected foreign members of the Geological Society of London.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society: Dr. W. E. Agar, Dr. F. W. Aston, Professor W. L. Bragg, Dr. W. T. Calman, Dr. A. Church, Professor G. Dreyer, Professor W. H. Eccles, Dr. J. C. G. Ledingham, Mr. C. S. Middlemiss, Professor K. J. P. Orton, Dr. J. H. Parsons, Professor J. C. Philip, Dr. A. A. Robb, Sir E. Tennyson D' Eyncourt, and Mr. G. Udny Yule.

THE council of the Chemical Society has awarded the Longstaff medal to Professor J. F.

Thorpe. The presentation was made at the annual general meeting on March 17.

LIEUTENANT EUGENE F. DU BOIS has been given the Navy cross "for distinguished service in the line of his profession while attached to the *U. S. Submarine N-5* upon the occasion of a collision between that vessel and the *Charles Whittemore.*

PROFESSOR A. A. MICHELSON, head of the department of physics at the University of Chicago, has been appointed exchange professor at the University of Paris. His course of lectures will be on the general subject of "Physics" and will be given in the French language. The sixth Guthrie lecture in connection with the Physical Society of London, was delivered on March 11 by Professor Michelson, whose subject was "Some recent applications of interference methods."

THE Rumford Committee of the American Academy of Arts and Sciences has recently made the following appropriations: To Professor P. W. Bridgman, of Harvard University, $400 in aid of his research on the thermal and optical properties of bodies under high pressure; to Professor Paul F. Gaehr, of Wells College, $250 in aid of his research on the specific heat of tungsten.

THE Carnegie Institution of Washington has appropriated $750 for the support of the work of Dr. S. J. Holmes, professor of zoology in the University of California, on the factors of evolution in man.

MR. EDWIN KIRK, who resigned from the U. S. Geological Survey in April, 1920, to do private work in South America, has been reinstated as geologist with the Survey.

PROFESSOR EDWARD KREMERS has returned to active service in the University of Wisconsin, after a semester's leave of absence spent largely on historical studies.

PROFESSOR E. W. D. HOLWAY, of the University of Minnesota, and Mrs. Holway, have returned from a year's exploration of the western slopes of the Andes in search of plant rusts. They went southward about as far as the island of Chiloé and northward to Quito, a range of forty degrees of latitude. Over a thousand numbers were secured, in most part supplemented by phanerogamic specimens of the hosts. The collection is notable for its large proportion of grass rusts.

DR. F. GOWLAND HOPKINS, professor of biochemistry at the University of Cambridge, will deliver the ninth Harvey Society lecture at the New York Academy of Medicine on Saturday evening, April 2. His subject will be "The chemical dynamics of muscle." Sir Walter Fletcher, secretary of the Medical Research Committee of Great Britain, will deliver a Harvey lecture on April 16.

THE following Mayo Foundation lectures have recently been delivered: President Ray Lyman Wilbur, of Leland Stanford University, "Botulism"; Dr. J. Whitridge Williams, professor of obstetrics in and dean of Johns Hopkins Medical School, "A critical review of twenty-one years' experience with Cesarean section"; Dr. G. Carl Huber, professor of anatomy, University of Michigan, "Experimental observations on bridging nerve defects."

DR. EDWARD C. FRANKLIN, professor of organic chemistry at Stanford University, will give a series of three lectures on the "Ammonia system of acid bases and salts," at the University of Wisconsin, on May 2 and 3.

A COURSE of twelve lectures on petroleum geology and the engineering phases of petroleum development was delivered during March at Harvard University by Frederick G. Clapp. Mr. Clapp also lectured before the Geological Conference in Cambridge, on "A geologist's trip through China."

DR. CHARLES A. SHULL, head of the department of botany of the University of Kentucky, has received an invitation from Dr. E. J. Russell, director of the Rothamsted Experimental Station at Harpenden, England, to present a paper on "Osmotic Phenomena" as related to soil moisture, before the Faraday Society at its next annual meeting at London in May. The meeting of the Faraday Society will be devoted this year to a symposium and general discussion on "Physico-chemical Problems relating to the Soil." The subject

will be presented in four sections, Soil Moisture, Organic Matter, Adsorption and Colloidal Phenomena; the general discussion being opened by Dr. Russell.

Dr. Frank W. Gunsaulus, since 1892 president of the Armour Institute of Technology, died in Chicago on March 17, aged sixty-five years.

The death is announced of Louis Compton Miall, F.R.S., till 1907 professor of biology at the University of Leeds, at the age of seventy-nine years.

Emile Bourquelot, professor of pharmacy in the University of Paris, has died at the age of sixty-eight years.

The fourteenth annual meeting of the Illinois State Academy of Science will be held at the Southern Illinois State Normal University, Carbondale, on April 29 and 30. Papers will be presented in the following subjects: (1) Biology and Agriculture; (2) Chemistry and Physics; (3) Geology and Geography; (4) Mathematics and Astronomy; (5) Medicine and Public Health; (6) Psychology and Education. The address of the retiring president will be "The Illinois Ozarks," and invitation addresses will be given on subjects concerned with southern Illinois. The afternoon and evening programs will be of a popular character and complimentary to the citizens of Carbondale.

The American Association of Pathologists and Bacteriologists, the American Society for Cancer Research, the American Society of Immunologists and the International Association of Medical Museums (American and Canadian Sections) will meet in Cleveland from March 24 to 26.

The American Engineering Council has joined with the National Association of Manufacturers, the American Patent Law Association, the American Chemical Society and the National Research Council in a movement to bring about reforms in the United States Patent Office. Conditions in the office, according to a statement issued by the council, are such as to menace seriously American industry and invention. A committee on patents has been appointed by the executive board of the council to prosecute a nation-wide campaign for the betterment of the patent office situation. This committee, as announced by President Hoover, is headed by Edwin J. Prindle, of New York, who represents the American Society of Mechanical Engineers on the council. The other members of the committee are J. Parke Channing, of New York, secretary, representing the American Institute of Mining and Metallurgical Engineers; Charles A. Terry, of New York, vice-president of the Westinghouse Electric and Manufacturing Company, representing the American Institute of Electrical Engineers; C. A. P. Turner, Minneapolis, American Society of Civil Engineers; Corydon T. Purdy, New York engineer, and Horace V. Winchell, mining geologist of Minneapolis, American Institute of Mining and Metallurgical Engineers; Dr. D. S. Jacobus, vice-president of Willcox & Babcock Company, American Society of Mechanical Engineers, and Frank H. Waterman, electrical expert of New York City, American Institute of Electrical Engineers.

The Lord President of the Council of Great Britain has appointed an Interdepartmental Committee on Patents to consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged as research workers or in some other technical capacity. The committee is to outline a scheme to give a fair reward to the inventor, and thus encourage further effort while protecting the national interest. Among the members of the committee are Dr. H. H. Dale, F.R.S., head of the department of biochemistry and pharmacology of the Medical Research Council.

At the Springfield meeting of the Association of Land-grant Colleges officers were elected as follows: *President,* H. L. Russell, of Wisconsin; *Vice-president,* Howard Edwards, of Rhode Island; *Secretary-treasurer,* J. L. Hills, of Vermont; and members of the executive committee, R. A. Pearson, of Iowa, chairman; W. M. Riggs, of South Carolina, W. E. Stone, of Indiana, A. R. Mann, of New

York, and F. B. Mumford, of Missouri. For the various sections the officers are as follows: Agriculture, Dean Mumford, chairman; W. F. Handschin, of Illinois, vice chairman, and W. H. Chandler, of New York, secretary; engineering, C. R. Richards, of Illinois, chairman, and R. L. Sackett, of Pennsylvania, secretary; and home economics, Edna L. Skinner, of Massachusetts, chairman, and Mildred Wiegley of Minnesota, secretary. For the three subsections of the section of agriculture, R. L. Watts, of Pennsylvania and C. D. Jarvis, of the U. S. Bureau of Education were chosen chairman and secretary, respectively, in resident teaching; F. S. Harris, of Utah and T. P. Cooper, of Kentucky, chairman and secretary in experiment station work; and H. J. Baker, of Connecticut and J. A. Wilson, of Oklahoma in extension work.

UNDER the auspices of the American Ophthalmological Society, the Ophthalmic Section of the American Medical Association, and the Academy of Ophthalmology and Oto-Laryngology, an International Congress of Ophthalmology will be held in Washington, D. C., April 18–22, 1922. The officers of the temporary organization are as follows: *President,* Dr. George E. de Schweinitz, Philadelphia; *Vice-president,* Dr. Edward Jackson, Denver; *Secretary* and *Treasurer,* Dr. Luther C. Peter, Philadelphia; *Chairman of Committee on Organization,* Dr. Edward C. Ellett, Memphis, Tenn.; *on Scientific Progress,* Dr. Edward Jackson, Denver; *on Finances,* Dr. Lee M. Francis, Buffalo; *on Arrangements,* Dr. William H. Wilmer, Washington, D. C., and *on Membership and Credentials,* Dr. Walter R. Parker, Detroit.

THE *Experiment Station Record* reports that plans are under way for a laboratory building for chemical, bacteriological and other research work of the Netherlands Institute of Animal Nutrition, and it is hoped to complete the structure in about two years. An annex to the laboratory is being built for immediate occupancy. This is a one-story structure about 117 by 62 ft., with basement and attic, and will be known as the vitamin laboratory. The main floor contains several offices and laboratories, but consists largely of quarters for mice, rats, monkeys, rabbits, fowls and guinea pigs. Special facilities are to be provided for keeping many of the animals in open warrens during the day, for disinfecting cages, and otherwise maintaining the best of hygienic conditions. The library is on the attic floor where considerable storage space is also available.

THE Association of British Chemical Manufacturers, as reported in the *British Medical Journal,* is circulating a memorandum on the present position of the fine chemical industry. The facts and arguments are on similar lines to those in the pamphlet issued from the Society of Chemical Industry. It is stated that British chemists, as a result of the stimulus imparted by the war, have brought the manufacture of the chemicals used in research and in photography, and of certain synthetic perfumes and essences, to the verge of commercial success, while the manufacture of drugs has made immense strides, and would have made greater had not the Order in Council prohibiting the importation of drugs been set aside by the Sankey judgment. The hope is expressed that the Key Industries Bill, which has been promised as a government measure of the new session, may do for fine chemicals what has already been done for dyestuffs by the act recently passed; that is to say, that some protection may be granted to the manufacturers of fine chemicals until they have consolidated a position which has been hardly won and which is still precarious. The insecurity arises from the fact that there are circumstances, including the great priority of organization, and also the present state of the exchanges, which favor the German laboratories. The national importance of this industry in peace and war is pointed out, and it is also stated that, excluding coal-mining, the fine chemical industry yields the highest net value of output per person employed.

As a result of the recommendations of the Wisconsin Chapter of the American Engineering Society, a bill has been introduced in the Legislature of Wisconsin providing for the registration of engineers, chemists, metallur-

gists and land surveyors. The proposed act calls for the registration of all members of these professions who practise their profession in the state of Wisconsin. It is understood, however, that only those persons whose practise of their profession involves the public health and safety will be affected by this law. In order to receive a certificate of registration an engineer or chemist must present evidence that he is fully qualified to practise his profession, and that he is of good character and repute, that he is at least twenty-five years of age and that he is a citizen of either the United States or Canada. The following—under the provisions of the proposed act—will be considered as evidence of the professional qualifications: 1. Ten or more years of active engagement in the profession. 2. Graduation, after a course of not less than four years, in chemistry, from a reputable college, and an additional four years of active engagement in the profession. The act provides for a board to apply the provisions of the act, for penalties in case of presentation of fraudulent evidence to obtain a certificate, and for penalties for those who practise fraud or deception in the practise of their profession.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Daniel Baugh a legacy of $150,000 has been left to the Jefferson Medical College of Philadelphia, to be used for the salary of the professor of anatomy and director of the Daniel Baugh Institute of Anatomy and Biology. J. Parsons Schaeffer, M.D., Ph.D., is the present occupant of these positions. Mr. Baugh was a trustee of the Jefferson Medical College and made generous gifts to it, including an institute of anatomy.

The graduate school of Yale University has been authorized to confer the degree of doctor of philosophy for work in clinical medicine, and in pharmacology and toxicology.

The University of Alabama, cooperating with the U. S. Interdepartmental Social Hygiene Board, has established a department of hygiene, with Dr. Hiram Byrd as director.

Dr. Eliot Blackwelder, of Denver, Colo., formerly associate professor of geology in the University of Wisconsin, has been appointed lecturer on geology at Harvard University.

Dr. E. W. Scripture, formerly of Yale University and the medical school of Columbia University, has been appointed to the faculty of the University of Hamburg for the summer semester, where he will lecture on English philology and experimental phonetics.

DISCUSSION AND CORRESPONDENCE

THE PREGLACIAL OUTLET OF LAKE ERIE

Two or three months ago an item went the rounds of the newspapers to the effect that in digging for the locks on the new Welland Canal, at Thorold, ten or twelve miles west of Niagara Falls, the workmen had uncovered evidence of the existence there of the long-looked-for preglacial outlet from Lake Erie into Lake Ontario. Partly for the sake of verifying this, I chose to spend my vacation at St. Catharines, two or three miles north of Thorold. Thorold is on the brink of the escarpment of Niagara limestone overlooking the Ontario basin and 330 feet above the surface of the lake. St. Catharines is at the base of the escarpment, nearly down to the level of the lake. At Thorold, as well as at various other places along the escarpment, there is a slight incision made by a small stream which poured over the escarpment in preglacial times. But it does not extend far. What was shown in the excavation for the Welland Canal was simply the edge of the escarpment where it had been rounded off by glacial action without lowering it to any extent. It is interesting and important to note that the movement of ice was here from north to south, almost at right angles to the escarpment. The workmen reported that at a low level just north of the escarpment a great quantity of bowlders was found, which would seem to be something of the nature of a moraine. As the ice met and overcame the edge of the escarpment it was occasionally deflected into a minor incision, but after it mounted the escarpment a long level sur-

face rock was exposed with beautiful parallel striation running north and south. The exposure, therefore, had nothing to do with the preglacial outlet, but it gave emphatic evidence that the ice movement was not in the direction of the axis of the lakes but directly across it, and hence could not be a means of eroding the lake basin.

The actual preglacial outlet of Lake Erie, however, emerges from the escarpment about three miles southwest of St. Catharines. This was discovered by Dr. J. W. Spencer and the evidence presented in great detail in his report published by the Canadian Survey in 1907, on "The Evolution of the Falls of Niagara," a volume of 500 pages in which the facts relating to Niagara Falls and the glacial phenomena of the peninsula between the lakes are presented with great fullness and accuracy. I could do little more than follow in Dr. Spencer's footsteps with this book in hand, to test the evidence. The results of Spencer's investigations are very impressive as one goes over the field. At the point mentioned there is an embayment in the escarpment, two miles wide at the level of the Niagara limestone; and lower down at the level of the Clinton limestone or Medina sandstone, the gorge is a mile wide filled with glacial debris which has been penetrated by wells to a considerable distance below the level of Lake Ontario. The glacial filling in the gorge, which originally rose to the surface, has been much eroded by Twelve Mile Creek and its tributaries which penetrate it, giving rise to a region known as the "short hills."

Three or four miles above the mouth of the gorge the line of the outlet is covered by a remarkable deposit of superficial glacial debris known as Font Hill which is something like an immense drumlin or kame and rises at its sumit 300 feet above the level of the Niagara escarpment and extends in a northeast-southwest direction between three and four miles, being at its widest point about a mile wide. The material shows stratification on the sides, such as appears in eskers. This accumulation is unique, and rises up like a mountain peak out of the level plain which extends all the way north to the Lake Erie basin. I will say nothing further about the theory of its origin at present; but will reserve what I have to say upon it for some future occasion when I may consider it in connection with some other unique glacial accumulations of that character in that region, notably, Berrymans Hill, about a mile west of Niagara Falls.

North of Font Hill, as has been said, there extends a level plain to Lake Erie and only fifteen or twenty feet above it. In this plain all preglacial channels are obliterated by the glacial deposits which form the surface; but Dr. Spencer had collected the record of wells all over the region, which show clearly that there is a continuous buried channel, about 200 feet deep, which emerges from Lake Erie just east of Lowbanks, about half way between the mouth of Grand River and the head of the Welland Canal at Port Colborne. There is, therefore, no doubt left that this "Erigan channel," as Dr. Spencer calls it, which emerges from the Niagara escarpment near St. Catharines is the real preglacial outlet to Lake Erie.

Dr. Spencer's investigations concerning the tributaries of this Erigan channel are also of special interest, and it was the facts, revealed by the well borings, concerning these that led to the real discovery. Chippewa River, which enters the Niagara just above the falls, rises twelve or fifteen miles west of the Erigan channel; but before it reaches the Niagara it crosses a buried channel which well borings show slopes from the Niagara River southwestward until it merges into the Erigan channel. Numerous other tributaries are found to do the same. Mr. Spencer's investigations deserve to be more widely disseminated to forestall the publishing of such items as that referred to at the beginning of this communication.

G. Frederick Wright

Oberlin,

RELATIVITY AND ESTIMATES OF STAR DIAMETERS

To the Editor of Science: In reducing the measurements of the diameter of Betelgeuse

made with Michaelson's wonderful apparatus, no allowance appears to have been made for the effect of the gravitational bending of light. Obviously this would make the apparent angular diameter greater than the real, and a rough approximation shows that this gravitational effect may be of the same or an even larger order of magnitude than the observed angle.

Knowing the parallax and being able to make an approximate estimate of the density, the true diameter of Betelgeuse may be determined with fair accuracy. I have made a rough calculation and find that it is approximately only one fifth of the diameter given, but the calculation should be made by others better fitted than I am.

Reginald A. Fessenden

THE CONSERVATION OF GAME AND FUR-BEARING ANIMALS

The New York State Conservation Commission issues *The Conservationist*. Among the many important communications in it, I wish to call especial attention to one, "New York's annual game dividend," written by Warwick S. Carpenter, secretary of the Conservation Commission.

On the basis of precise data the conclusion is reached that the game and fur-bearing animals of New York state, if capitalized, are worth not less than $53,000,000; they return an annual dividend of more than $3,200,000; and they cost the state for their protection and increase the nominal sum of $182,000. This cost of protection and increase is thus less than six per cent. of the annual dividend.

There is need for emphasizing the financial as well as the æsthetic and scientific sides of the conservation problem and these findings of Mr. Carpenter deserve wide publicity.

Henry B. Ward

SCIENTIFIC BOOKS

A Laboratory Manual of Anthropometry. By Harris H. Wilder, Ph.D., Professor of Zoology, Smith College, Northampton, Mass. 200 pp., 43 illus., P. Blakiston's Son and Co., Phila., 1920.

In order that the records of each observer may be readily made use of by every other observer, it is imperative that series of measures be uniform and be taken in uniform ways. The matter of unification was first placed upon an international basis by the International Congress of Anthropologists held at Monaco in 1906. The unification process was carried still further at the Geneva Congress in 1912. There remain for consideration at some future Congress the general skeletal measures, exclusive of the cranium and lower jaw.

The work of the special International Commissions rightly forms the basis of Wilder's Laboratory Manual. However his statement on page vi of the Preface, that the periodicals in which the reports of the labors of the two Commissions "appeared were exclusively European," is incorrect; for a report from the reviewer's pen, of the work accomplished at Geneva, translated from the official copy of Dr. Rivet, chief recorder of the Commission, appeared both in Science[1] and in the *American Anthropologist* for the year 1912.

To the measures accepted by international agreement, the author adds a convenient and useful list of general skeletal measures, as well as angles and indices. No mention is made of the Sphenomaxillary angle, which might well find a place even in an abridged manual. His enumeration of instruments and description of the manner in which they are employed are done with a thorough knowledge of the difficulties which beset the beginner. The pages devoted to simple biometric methods were written for the special benefit of the student, whose chief interest is in morphological relations, and whose mathematical ability and training are not sufficient to enable him to follow abstruse biometric methods.

To the laboratory student of the subject, Wilder's Manual is recommended for its lucidity and conciseness, as well as for the author's ability to transmit a maximum amount of his own pervading enthusiasm for the subject by means of the printed page.

[1] Vol. XXXVI., 603–608, November 1, 1912.

For good measure, two instructive appendices are added: *A*. Measures of Skulls of 93 Indians from Southern New England; *B*. Bodily Measures of 100 Female College Students.

George Grant MacCurdy
Yale University,
New Haven, Conn.

THE PRODUCTION OF BIOLOGICAL STAINS IN AMERICA

Bacteriologists, during the war time, were often hindered in important work, sometimes involving matters of health control, by the lack of dyes which they were accustomed to use for staining. Some laboratories were provided with a sufficient supply of Grübler stains to use all through the war and are only now running out of this supply; but others were early forced to buy stains of American manufacture. Some of the American stains were so poor as to be unhesitatingly condemned, others although enough for some purposes were not suitable for the particular objects of bacteriologists, while others were so variable as to be unreliable.

Now that the war is over, biological scientists and their supply houses are faced with the problem whether to urge the importation again of German stains (which can now be done only with special permit) or to encourage the establishment of an American source of supply. As scientists we have no objection to the use of German-made materials, and if no other solution of the problem can be found we will be willing enough to consider the Grübler stains standard again, as soon as they can be freely obtained. From the standpoint of national independence, however, it seems well first to see what American producers can do for us in this line, especially when it is considered that certain stains are important to public health and that we ought to be able to count on an uninterrupted supply if there should ever be a new national emergency when importation would become impossible.

The Committee on Bacteriological Technic was asked by the Society of American Bacteriologists to look up the matter, to see whether reliable stains can be obtained in this country and further to see what can be done to protect bacteriologists against the unsatisfactory stains that are put upon the market. Upon looking into the situation we find that all the bacteriological dyes, and nearly the whole list of biological anilins are produced in America in reliable form. The chief difficulty is that there are too many competitors in the field for such a small line of business. Grübler apparently examined all the available textile dyes and determined which were useful to biologists, standardizing them so that the stains bearing his name were uniform. Then he sold them at a high percentage profit, but a perfectly legitimate profit, considering the labor he saved biologists by the study he gave the subject. A number of American concerns, attracted by the great difference between the cost of crude dyes and the price of biological stains, have thought to realize quite a profit from the business, and have begun the "manufacture and standardization" of biological dyes—often to their own discomfiture, but always to the discomfiture of the users of the stains. For a while there was success for all, because a scientist would give any firm a single test; but the result was a needless duplication of dyes of the same name, sometimes alike, but often different, and also the introduction of new names for old dyes. Although some of these concerns are now going out of business, the confusion still remains.

Gradually the users, or at least the distributors, have been learning which houses are manufacturing the most satisfactory stains, and the less reliable manufacturers have been forced out of the business. But the present situation is such that the future importation of German stains is no longer regarded as impossible. Fearing competition from abroad as well as from the unreliable concerns at home, some of the best producers of biological stains are becoming discouraged and are abandoning the effort to increase their line. Under these circumstances the only way to assure the continued domestic

production of stains is through the cooperation of scientists. After determining some one reliable line of stains we should make this line standard as the Grübler stains were once, and discourage the entrance of new manufacturers into this rather limited field. The line selected as standard need not be all the output of any one laboratory; but the production of *any one stain* in several different laboratories is an unnecessary waste of effort. All the distributors of stains are anxious to avoid this sort of duplication, and whenever one has been approached in the matter, most hearty cooperation has been assured us.

To carry out this program means considerable preliminary work to determine which of the domestic sources of each stain is the most reliable. Although we have considerable light on this subject already, and can in many cases make private suggestions of possible value to purchasers, we have not as yet the data necessary for making any official statement. We are now planning a series of tests of the most important bacteriological dyes in a considerable number of different laboratories, the outcome of which may determine our future action in the matter. As a society of bacteriologists we are of course primarily interested in the most commonly used bacterial stains, such as fuchsin, methylen blue, the gentian violet group, and the prepared blood stains. Secondarily, however, we are interested in securing the cooperation of other biologists in an attempt to standardize eventually the whole field.

This article is being written in the hopes of securing this cooperation. We wish to invite other biologists as individuals and through their organizations to work with us in the matter. Any one interested in our purpose is urged to communicate with the committee.

H. J. Conn, *Chairman,*
Committee on Bacteriological Technic, of the Society of American Bacteriologists
Agricultural Experiment Station,
Geneva, N. Y.,
March 1, 1921

SPECIAL ARTICLES

THE STRUCTURE OF THE STATIC ATOM

In attempting recently to derive the conditions which determine the stability of chemical molecules I was impressed by the importance of the part played by Coulomb's law of inverse square forces between charged particles. In fact, by considering a static arrangement of electrons according to the models which I proposed two years ago, and calculating the total potential energy by Coulomb's law, I have found it possible not only to determine the relative stability of various substances but to calculate with reasonable accuracy the heats of formation of compounds even of widely varying types.

In all such calculations, however, it is necessary to assume that the electrons are kept from falling into the nucleus by some undetermined force, for Coulomb's law alone can not account for this. According to Bohr's theory of atomic structure, the requisite repulsive force is nothing more than centrifugal force due to rotation of the electrons about the nucleus. This theory has been so remarkably successful in accounting for the spectra of hydrogen and helium that the fundamental assumption of movement about the nucleus has seemed justified, notwithstanding the fact that this violates all our classical laws regarding the radiation of energy from accelerated electrons.

From the chemical point of view it is a matter of comparative indifference what the cause of the repulsive force is, so long as it exists. I therefore endeavored to find what law of repulsive force between electrons and positive nuclei would produce an effect equivalent to the centrifugal force of Bohr's theory.

According to Bohr the average kinetic energy in any atom or molecule is half as great as the average potential energy, but opposite in sign. I therefore now assume that this energy, which Bohr called kinetic, is another form of potential energy dependent upon certain quantum changes in the electron.

From this potential energy it is then easy to determine the law of repulsive force.

The result of this analysis is that we may regard the force between any nucleus of charge Ze and an electron of charge e as consisting of two parts which act independently. The first is the Coulomb attractive force F_c given by

$$F_c = \frac{Ze^2}{r}. \tag{1}$$

The second force, which we may call the *quantum force* is a repulsive force F_q given by

$$F_q = \frac{1}{mr^3}\left(\frac{nh}{2\pi}\right)^2. \tag{2}$$

In these equations r is the distance between the electron and the nucleus, m is the mass of the electron, h is Planck's quantum, and n is an integer denoting the quantum state of the electron. This repulsive force, varying inversely as the cube of the distance, is remarkable in that it is independent of the charge on the nucleus. It is to be noted especially that an electron which has not undergone any quantum change and for which therefore $n = 0$, follows Coulomb's law accurately. Thus presumably β-rays in passing through an atom will be acted on only by the usual law.

It can be readily shown that under the influence of these two forces an electron will be in stable equilibrium when it is at a distance from the nucleus equal to

$$a = \frac{n^2 a_0}{Z}, \tag{3}$$

where a_0 is given by

$$a_0 = \frac{h^2}{4\pi^2 me^2}. \tag{4}$$

This result is identical with that for the radius of the orbit in Bohr's theory, but of course the law of force was chosen to give just this result.

If W is the total energy of the system with its sign reversed we obtain

$$\frac{W}{W_0} = \frac{2Za_0}{r} - \frac{n^2 a_0^2}{r^2}, \tag{5}$$

where

$$W_0 = \frac{2\pi^2 me^4}{h^2}. \tag{6}$$

Equation (5) has no equivalent in Bohr's theory for it applies to the transitions between stationary states. The first term in the second member represents the Coulomb potential while the second corresponds to the quantum potential.

When an electron has settled down into its position of equilibrium, the value of W becomes

$$W = \frac{Z^2 W_0}{n^2}. \tag{7}$$

This also is identical with the result obtained by Bohr for the total energy in any stationary state. It follows from this that the Rydberg constant, the Balmer series and all other series calculated by Bohr can be obtained by this method without assuming electrons moving about the nucleus.

If the electron is disturbed from its position of equilibrium it oscillates about this position. From equation 5 the frequency of this oscillation is found to be

$$\nu = \frac{4\pi^2 Z^2 me^4}{n^3 h^3}. \tag{8}$$

This is identical with the frequency of revolution of the electron in Bohr atom. From this we may draw a definite physical picture of the mechanism of the transition between two states, at least when Z is large. Bohr has shown that under these conditions the frequency radiated when an electron passes from one circular orbit to the next inner one is the same as the frequency of revolution. According to the present theory, if the quantum number of an electron in a stable position decreases by one unit, the electron is no longer stable but falls towards its new position of equilibrium, and oscillates about this position. It then radiates its energy of oscillation according to the usual laws of electro-dynamics.

One of the greatest successes of the Bohr theory is that it accounts for certain slight differences between hydrogen and helium lines

by the nuclear mass correction. This correction is taken care of in the present theory with the same accuracy if we assume a slight modification to our law of quantum repulsion, viz. replace equation (2) by

$$F_q = \left(\frac{nh}{2\pi}\right)^2 \frac{\frac{1}{m} + \frac{1}{M}}{r^3}, \qquad (9)$$

where M is the mass of the nucleus. This seems to indicate that the quantum force is due to an interaction between the electron and the nucleus in which both masses play a similar rôle. For example, it may be imagined that both are set into rotation in opposite directions about the axis connecting them.

Sommerfield has accounted for the fine-line structure of spectral lines by considering a relativity correction due to the rapid motion of the electron. This would seem to be excellent proof that the electrons do move. However, it is possible that the motion resides within the electron and nucleus. It is probably significant that the relativity correction can be taken into account in the present theory if we substitute in equation 2 in place of n^2 the expression

$$(n_a + n_r)^2 - \alpha^2 Z^2 \left(\frac{n_r}{n_a} + \frac{1}{4}\right), \qquad (10)$$

where α is a constant calculated by Sommerfeld. A consideration of this equation may lead to more definite conceptions of the structure of the electron and nucleus. The quantities n_a and n_r refer to what Sommerfeld calls angular and radial quanta. It is not yet clear just what interpretation is to be placed upon these in the present theory but they are evidently only of secondary importance in determining the forces between the electrons and the nucleus.

When we consider other atoms such as helium it seems as if the new theory may lead us much further than the usual theory, for the determination of equilibrium positions under static forces is extremely simple compared to the corresponding dynamical problem. Furthermore we are not troubled by mysterious quantum conditions which are theoretically applicable only to periodic orbits while the calculated orbits in atoms are not periodic.

At present I am studying the spectra of helium and lithium from this viewpoint. The following tentative conclusions may be stated.

The quantum force between quantized electrons is not as simple as between electrons and nuclei. The quantum force between electrons on opposite sides of a nucleus is one of repulsion whose magnitude is approximately given by equation (2) if the quanta are all of the "angular" type, but is considerably less when the quanta are of the "radial" type. But if the electrons are on the same side of the nucleus, the quantum force between electrons is one of attraction, also given approximately by equation (2). Thus if one of the electrons in the helium is uniquantic, and the other one is diquantic, the latter can take equilibrium positions either on the opposite side of the nucleus from the uniquantic electron or on the same side. This perhaps explains the fact that helium (as well as other elements with two outer electrons such as calcium, etc.) has two separate complete sets of spectra (helium and parhelium). It is also in accord with the remarkable facts in regard to the helium spectrum which were recently pointed out by Franck and Reiche.

These properties of the electron are in full accord with those which are needed to account for chemical relationships. The new theory fulfills the predictions of G. N. Lewis who in 1916 wrote[1] in reference to Bohr's theory:

> Now this is not only inconsistent with the accepted laws of electromagnetics but, I may add, is logically objectionable, for that state of motion which produces no physical effect whatsoever may better be called a state of rest.

It is also in accord with the conclusion which I gave in a paper entitled "The properties of the electron as derived from the chemical properties of the elements,"[2] viz.:

[1] *Jour. Amer. Chem. Soc.*, 38, 773 (1916).
[2] *Phys. Rev.*, 8, 300 (1919).

How can these results be reconciled with Bohr's theory and with our usual conception of the electron? It is too early to answer. Bohr's stationary states and the cellular structure postulated above have many points of similarity. It seems that the electron must be regarded as a complex structure which undergoes a series of discontinuous changes while it is being bound by the nucleus or kernel of an atom. There seems to be strong evidence that an electron can exert magnetic attractions on other electrons in the atom even when not revolving about the nucleus of the atom.

Irving Langmuir

Research Laboratory,
General Electric Co.,
Schenectady, N. Y.,
March 8, 1921

THE OKLAHOMA ACADEMY OF SCIENCE

The ninth annual meeting was held in Oklahoma City on February 11, at the State University, Norman, on February 12. The following papers were read:

Presidential Address: *Research in secondary schools:* A. F. Reiter.

The organization of a research council in Oklahoma: Guy Y. Williams.

On the affiliation of the Oklahoma Academy of Science with the American Association for the Advancement of Science: L. B. Nice.

The ceremonies and rites incident to eating peyote among the Cheyenne Indians: J. B. Thoburn.

The intrinsic-extrinsic mechanism of heredity and variation: H. H. Lane.

An eccentric hen—anatomically excused: A. F. Reiter.

On the non-singular cubic: Nathan Altschiller-Court.

A survey of the taxation system of Oklahoma: F. F. Blachly.

The teaching efficiency of motion pictures measured in terms of results secured under schoolroom conditions: J. W. Sheppard.

Where did the Indians of the Great Plains get their flint? Chas. N. Gould.

An objective view of education in Oklahoma: Miriam E. Oatman-Blachly.

The most important scientific spot on earth: Walt B. Sayler.

An observation on the male Dickcissel during the nesting period: Ed. Crabb.

The genetic evidence of a multiple (triple) allelomorph system in bruchus and its relation to sex-limited inheritance: J. K. Breitenbrecher.

Some studies with complement deficient guinea pigs: H. S. Moore.

The migration path of the germ cells in fundulus: A. Richards and J. T. Thompson.

Nesting of mourning doves at Norman in 1920: Margaret M. Nice.

Some notes on winter birds around Norman in 1920–21: Margaret M. Nice.

A comparison of the rate of diffusion of certain substances, particularly the food materials, enzymes and pro-enzymes: Alma J. Neill.

Further observations on tonus rhythms in diaphragm muscle: L. B. Nice and A. J. Neill.

A child's deviations from truth: Sophia R. Altschiller-Court.

The range of vocabulary at eighteen months of age: Miriam E. Oatman-Blachly.

Relation of science to art: Lucille Carson.

The bank of Missouri: J. Ray Cable.

A plan to reach the Orinoco sources: T. A. Bendrat.

The cliff-dwellers in Mesa Verde Park, Colorado: C. W. Shannon.

A trip across the Navajo desert: Juanita Ramsey.

Evidence on the Pennsylvania glaciation in the Arbuckle Mountains: S. Weidman.

Toyah, Texas, oil pool: Bess Mills.

The Marietta syncline and its effect upon the physiography of Love County: Fred Bullard.

Deep tests in southwestern Oklahoma: Waldo Ports.

Protozoa of Colorado: T. C. Carter. (Read by title.)

The grand period of growth of root-hairs: R. E. Jeffs. (Read by title.)

During the session it was voted to affiliate the Oklahoma Academy of Science with the American Association for the Advancement of Science forming two classes of members, local and national.

It was also voted to establish a State Research Council in the Oklahoma Academy of Science along the same plan as the National Research Council.

It was further voted to establish a Natural History Exchange for the purpose of assistance in building museums in the colleges and high schools of the state.

The following resolutions were adopted:

1. Whereas, it is highly desirable to save the wild life in the state, the Oklahoma Academy of Science places itself on record as favoring the making of all state, municipal or other public lands and waters into game preserves.

2. Whereas, hawks and owls have been shown by the United States Biological Survey to be of far more benefit to agriculture than injury, the Oklahoma Academy of Science places itself on record against the bill now pending in the Oklahoma legislature to put a bounty on these birds.

3. Whereas, the Oklahoma Academy of Science wishes to encourage research in all branches of science, and good library facilities are absolutely necessary for such work, the Oklahoma Academy of Science places itself on record in favor of passing the bill now before the Oklahoma legislature to appropriate $50,000 to establish a State Industrial Library at the University of Oklahoma.

4. Whereas, it is to the best interest of science in the United States to have the metric system to be the standard of weights, the Oklahoma Academy of Science places itself on record in favor of the bill now pending before the United States Congress to change from our present standard of weights to the metric system.

5. Whereas, complete protection of the natural parks of the United States is essential to the happiness of the people for all generations to come, and

Whereas, the Smith bill which has recently passed the United States Senate and is now pending in the House, and also the Walsh bill, pending in the Senate, would throw open the Yellowstone National Park to predatory wealth, thus depriving the people of one of the most beautiful pleasure spots in the world, the Oklahoma Academy of Science places itself on record as being opposed to both of these bills.

The following officers were elected for the ensuing year:

President, J. B. Thoburn, Oklahoma City.
First Vice-president, Guy Y. Williams, Norman.
Second Vice-president, R. O. Whitenton, Stillwater.
Secretary, L. B. Nice, Norman.
Treasurer, H. L. Dodge, Norman.
Curator, Fred Bullard, Norman.

L. B. Nice,
Secretary

Norman, Okla.

THE WESTERN SOCIETY OF NATURALISTS—NORTHWEST SECTION

The Northwest Section of the Western Society of Naturalists met at the Oregon Agricultural College, Corvallis, Friday and Saturday, November 26 and 27, 1920. The following papers were presented at the session Friday afternoon:

Explosion of crab spermatozoa: Nathan Fasten, Oregon Agricultural College.

Some early botanists of the Northwest (illustrated): Albert R. Sweetser, University of Oregon.

A fossil cetacean from the Miocene of Newport, Oregon: E. L. Packard, University of Oregon.

Neuromotor apparatus in ciliates: H. B. Yocom, University of Oregon.

Records in eugenics: Catherine W. Beekley, University of Oregon.

Friday evening a dinner to the visiting biologists was given at Waldo Hall by the Biological Club of Oregon Agricultural College. The program following the dinner consisted of a symposium on "Biology in its relation to the development of the Northwest." The subject was discussed from the following standpoints:

Forestry: H. S. Newens, Oregon Agricultural College.

Horticulture: W. S. Brown, Oregon Agricultural College.

Zoology: Trevor Kincaid, University of Washington.

Fisheries: E. Victor Smith, University of Washington.

Fish Parasitism: Nathan Fasten, Oregon Agricultural College.

Biological Stations: Geo. B. Rigg, University of Washington.

Dr. S. M. Zeller, of Oregon Agricultural College, was elected secretary for the coming year. It was decided to hold the next meeting at the University of Washington, Seattle, during the Thanksgiving recess, 1921. The Northwest Section embraces Oregon, Washington, Idaho, Montana, Wyoming and British Columbia.

Geo. B. Rigg,
Secretary

SCIENCE

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FRIDAY, APRIL 1, 1921

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

AN ILLUSTRATION OF PRACTICAL RESULTS FROM THE PROTECTION OF NATURAL RESORUCES

ABOUT fifteen years ago a highly enlightened administration of the government of Peru became interested in the decline of the country's valuable guano industry and the apparent diminution in number of guano-producing birds. It was the privilege of the writer to be engaged by the Peruvian government for an investigation of the condition of the guano industry and the possibilities of its preservation, as well as for studies relating to the fisheries and to the marine fauna and flora. On my arrival in Lima I was impressed with the alert attitude of government officials in reference to the guano industry and with their anxiety to take whatever measures might, as the result of careful investigation, be found conducive to the conservation of the guano birds. A most significant preliminary step had indeed already been taken through the closure of the three Chincha Islands.[1] After an extended investigation, a series of recommendations for the general regulation of the guano industry was submitted to the Director de Fomento, and, with his approval, the report was reproduced in SCIENCE for July 10, 1908. A few excerpts from that report will be illustrative.

2. The present tendency to decrease in numbers (of birds) may be checked. There is a wealth of reliable testimony from the older men of long experience in the industry, that the useful birds, . . . were formerly vastly more abundant than now. . . . If they have endured the treatment they have received without decrease in numbers, then pro-

[1] Two of the islands were shortly opened for guano extraction under pressure of circumstances, but the South Island remained closed through three breeding seasons, affording a convincing demonstration of the utility of the measure. (See "Habits and Economic Relations of the Guano Birds of Peru," *Proc. U. S. N. M.*, Vol. 56, p. 484.)

tection can hardly be worth while. On the other hand, if it is true, as represented by every one who should know, that there has been a great diminution in number of birds, then—

3. *We may hope that the protection of the birds will result in a great increase in their numbers.* Before the working for guano on a large scale began and before the nesting grounds began to be plundered for eggs and fowls, the birds must have existed in a condition of abundance dependent upon their food supply, their enemies and their natural prolificness. New factors have entered in recent years which have caused the birds to decrease materially below this *normal condition of abundance.* If these unfavorable factors are removed by well-considered and well-executed protective measures, why may we not see an increase in number toward the former normal abundance?

I think it conservative to say that the proper protection of the birds means the saving to Peru of hundreds of thousands of dollars' worth of guano each year. . . .

We . . . may well plan for protective measures that are intended to work progressively to the advantage of the industry for the next twenty years or more. We want to see many more birds in 1915 than are present in 1908, and more birds in 1920 than in 1915; and this will not be accomplished by routing the birds from their nesting grounds as soon as they are fairly established.

The general plan of protection comprised the following essential elements.

1. The admission of but a single concessionist to an island or a group of islands in order to eliminate the vigorous competition which was resulting in utter disregard of the needs of the birds, requiring also that the concessionist, through a resident representative on each island, should be held responsible for the fullest protection of the birds.

2. The closing of islands for periods of years.

3. The continuation of the existing yearly closed season of months.

4. Placing the extraction of guano for national agriculture in the hands of a single company, which would thus "be induced to plan for the future."

5. Adjustment with the Peruvian Corporation, Limited, whereby detrimental competition between the exporting corporation (to which a considerable portion of the guano was mortgaged) and the national company might be obviated.

The problem before the government, the national agriculture, and the exporting company, is this: How can the guano industry be saved to the future? Certainly no legitimate interest can be furthered by a continuance of the present unsatisfactory system, with its sacrifice of the birds.

I think the solution of the problem will be furthered if we put the question in this way: What system of regulation will result in the greatest annual deposit of guano twenty years hence?

It was a comparatively easy matter to offer recommendations, but an extremely difficult one to give them effect, because of complications arising from the heavily mortgaged condition of the guano deposits, the inadequacy of the current deposits for the use of national agriculture, and the restive internal conditions which culminated, shortly after the recommendations were presented, in the most serious revolutionary movements known in many years. The matter of the preservation of the guano industry was not, however, lost track of altogether, and it is understood that several of the measures proposed were given effect at an early date. A later government took up the matter again in a serious way and enlisted the services of Professor S. O. Forbes of England who made a careful study of the conditions and submitted a comprehensive report to the Peruvian government. As this report has not been published it can not, unfortunately, be cited in this connection. It is evident that the protective measures now in effect are based upon the essential principles outlined above. The extraction of guano for national agriculture was placed in the hands of a single organization, the Compañia Administradora del Guano, directly responsible to and regulated by the government. Suitable adjustments were made with the Peruvian Corporation Ltd. The closed season was continued, and the closing of islands for periods of years became an established part of the plan of regulation. Guardians were put upon the several islands.

As to the results, we have convincing testimony from Dr. Robert Cushman Murphy, of the Brooklyn Institute of Arts and Sciences, who has recently visited Peru and given especial attention to the birds of the guano islands. Some of his observations are comprised in a series of papers of fascinating interest entitled "The Sea Coast and Islands of Peru" appearing in current numbers of the *Brooklyn Museum Quarterly*. I quote from the last number (October, 1920, p. 250).

The first undertaking of the Compañia Administradora del Guano under the able directorship of Senor Francisco Ballen, was to make each of the numerous guano islands a bird sanctuary, closed at all seasons of the year to unauthorized visitors. Competent guardians with duties scarcely less exacting than those of lighthouse keepers, were posted as permanent residents upon every group. Clandestine guano extraction, the stealing of birds' eggs for food or for the use of the albumin in clearing wine, and other disturbances which had formerly caused havoc in the colonies, ceased at once. The old method of extracting guano without regard to the presence or physiological condition of the birds has, of course, been abolished, the islands, under the new rule, being worked according to a system of rotation which leaves ample and congenial breeding grounds always available. Courting or nesting birds are now carefully shielded from disturbance. Moreover, after removal of the guano, an island is promptly vacated and is thereafter given over to the complete possession of the birds for a period of approximately thirty months, at the expiration of which the date for a renewal of digging operations is determined only after careful reconnaissance.

The régime of the Compañia Administradora del Guano, with its well-balanced regard for both business and conservation, has resulted in a nearly uniform increase in the annual increment of guano, as well as a promising outlook for a continually augmenting supply while the birds are repopulating the breeding grounds to the limits imposed by space and the nutritive resources of the littoral ocean. Since 1910, the administration has issued an annual "Memoria" containing statistical data, from which the following table of production has been taken:

Seasons	Guano Production
1909–1910	25,370 tons
1910–1911	24,921 "
1911–1912	18,636 "
1912–1913	24,350 "
1913–1914	31,486 "
1914–1915	24,446 "
1915–1916	43,721 "
1916–1917	59,208 "
1917–1918	87,898 "
1918–1919	80,517 "

The slight fluctuations in the column are doubtless due to the fact that no island is worked two years in succession, which results in a somewhat disproportionately large yield for the seasons in which the product of the most important islands is included. In a letter dated August 24, 1920, Senor Ballen writes that the guano output for the current year will exceed 82,000 tons, of which 70,000 tons will be required by native agriculturists and 12,000 tons will be at the disposal of the Peruvian Corporation for export. It should be understood that the tabulated figures refer to newly deposited guano, for the so-called "fossil" beds have been long since exhausted except upon Lobos de Tierra and Lobos de Afuera.

Most instructive deductions may be made from the table of guano production just quoted. In the first place, it is evident that in the early years of the period covered the annual production of guano was approximately as estimated in 1908, *i.e.*, from 20 to 25,000 tons per annum. In the second place, it appears that, beginning about 1913, the annual production of guano (proportioned in large measure to the abundance of producing birds) has risen to more than 80,000 tons at the present time. The production now is approximately three times as much as it was ten years ago. In 1908 the annual deposits were far below the estimated requirements of national agriculture, disregarding the export requirement. In 1920 the production substantially exceeds a greatly increased requirement for national agriculture so that a moderate export may be carried on even without sacrifice of internal requirements. The government derives revenue of more than a million dollars a year from the extraction of guano, a reasonable profit accures to the Compañia Administradora, and presumably to the export

corporation, while Peruvian planters obtain the most valuable fertilizer at a price which our American farmers would consider astonishingly low.

Now, in the words of Captain Cuttle, "The bearings of this observation lays in the application on it."

In the first place, one of the essential principles upon which this scheme of protection is founded is that of closure of breeding grounds in rotation *for periods of years.* This principle must be distinguished from the common measures of protection through closed seasons or the establishment of permanent sanctuaries. While the latter is in many cases an ideal method of protecting animals, it is of course impracticable of application in the case of guano birds and many objects of chase or fishery.

Closed seasons of a few months produce good results in many cases, but such a principle of protection has the defect (often unappreciated) of being based upon an assumption that nothing essential to reproduction takes place except when the reproductive activities are externally evident. It seems sometimes to be assumed that destruction or disturbance of an animal *before* it spawns makes no difference. The closed season of months has, to be sure, its proper place, and is often the only feasible measure.

The second application is that the plan of temporary sanctuaries, as applied to guano-producing birds, has evidently worked and produced the desired results in high degree. The annual production has been *trebled* in ten years. Why then can not the plan be more generally applied in the case of natural objects requiring protection? It seems to be based upon a proper appreciation of physiological, "social" and ecological conditions as affecting successful reproduction. This is the principle, by the way, which for eight years has been advocated for the preservation of the fresh-water mussel resources of our interior streams, but which is as yet being given effect in a small way in only two states.

A final application to be made in this connection is not the least in importance. The enforcement of any broad and effective plan of protection of guano birds was confronted ten or twelve years ago with obstacles which one might fairly have considered insurmountable: foreign obligations with their customary difficulties of adjustment; national agricultural demands so exceeding the yearly production as to make temporary curtailment most aggravating to Peruvian agriculturists; restive political conditions such as usually demand the service of the present rather than of the future. How do such difficulties compare with those which confront the protection of fresh-water mussels or the development of the oyster industry in the Chesapeake Bay, for example? Surely, as Dr. Murphy has appropriately suggested, credit is due primarily to the patriotic and far-sighted citizens of Peru who accepted the preliminary sacrifices and *did what was evidently needed to be done.*

When we consider that the conservation measures cited were so promptly and fruitfully executed in one of our sister republics south of the equator it ought to "give us pause"—or else it should stimulate us to stop pausing and proceed to take like care of some of our own natural resources.

R. E. Coker

Bureau of Fisheries

NATIONAL TEMPERAMENT IN SCIENTIFIC INVESTIGATIONS

We have too long adjusted our scientific thought to the temperature of a European atmosphere. It should not be necessary to guard the voice of our scientists against the unnatural accent of the parrot. What was true of literature when Emerson read before the Phi Beta Kappa Society at Cambridge his celebrated oration on "The American Scholar" is now true of scientific investigation in the United States. "We have listened too long to the courtly muses of Europe." We have too much taken our problems from European investigators and have too little allowed nature to ask her own questions of us. These problems we have treated too much in the spirit of European (and

especially of German) investigation. Too little have we allowed rein to our own individuality in the choice of subject and the development of method.

Let it be granted that the people of Europe have attacked the problems and developed the methods best suited to their needs and their temperament. This seems to be true. The several important groups, following their own native inclinations, have marvelously succeeded in organizing nature in useful ways and have made conquests of the forces of the environment never approached by any other peoples. They have acted upon the realization that the best truth which any mind or any nation can create or discover is that which comes to it in the course of spontaneous activity. When we so proceed that our thinking is a natural expression of our native bent our discoveries will become typical of ourselves and we shall render into the whole worth of mankind a good which we can not attain by following the lead of another people. "He is great who is what he is from nature and who never reminds us of others."

Let us not run after the ways of another people. Let us also not run from the ways of another people. Let us follow our own ideals; let us develop our own spirit in the search for truth; let us be just to our own temperament. Our civilization is based on our European origin. We can not escape that fact. There is no need to try to run away from the nature which we have inherited. But there is a fundamental necessity that our thought shall not try to follow in the way pointed out by European thinkers of to-day; just as it is important that Europe shall continue to think in her own way and not seek to be guided by us.

We are a combination of social units which have not existed together before and are not now to be found together elsewhere. In some measure and in some phases we have developed our own national intellectual spirit; the present progress in American poetry, for instance, is not inspired by European models but is a native product arising from the basic foundation inherited from our European ancestry. But in scientific matters we still have a great tendency to attack problems set by European investigation rather than to follow our own more spontaneous activity and so find that truth which our temperament makes it possible for us to discover more easily than any other people.

Our attitude in this respect is strongly contrasted with that of the great nations of Europe. They have proceeded in ways of their own. Though science is cosmopolitan the scientific work of the greater groups in Europe is national in spirit. Notwithstanding the close interactions of the modern world and the systematic exchange of scientific knowledge, national traits find spontaneous expression in the researches of different countries.

British science is characterized by the spontaneity and individuality of the workers, with consequent large power in fundamental conceptions, so that a greater measure of dominant ideas in the science of to-day goes back to them perhaps than to those of any other people. They do not congregate in distinct schools and institutions. They are not localized in definite centers. No army of well-trained intellectual workers exists among them. No compact body of pupils there develops the work and ideas of any master. The self-reliant strength of natural genius dominates the scientific spirit. The British have produced a disproportionate number of new ideas and great departures. They have no university eager to nurse and develop new talent, so that the new thinker becomes devoted to nature. He lives close to the heart of things and nature rewards his independence of other thinkers.

German science is remarkable for the organization of the investigators and the resulting wealth of detail in developing the consequences of fundamental ideas once introduced and in preparing indexes and summaries of the current literature of discovery. The universities of Germany form the most characteristic institution of the German mind and afford the most perfect expression of its essential character, especially as regards sci-

entific work. These universities form one of the greatest intellectual agencies of the modern world. Among them arose the now universal habit of looking upon private study and research as a necessary qualification of the teacher. They teach not only knowledge but also research. To them largely is due the fact that German investigators stand under the generalship of a few great leading minds. They, more than any other single force, should be credited with the fact that so many persons in Germany are devoted to the pure ideal of knowledge for its own sake.

It is true that this ideal had been somewhat dimmed, even before the Great War, by the incessant demands of utilitarian motives; but it is to be hoped that it will again come into the ascendency and once more renew faith in the importance of the more ideal values.

There is danger that the ideal of knowledge for its own sake may dull the sense of values and lead one to a practise of treating trivial things with the same care as the matters of great moment. Indeed it seems that the Germany of the past has suffered in this respect.

> In no country has so much time and power been frittered away in following phantoms, and in systematizing empty notions, as in the Land of the Idea.

Emerson somewhere employs a beautiful fable of antiquity, pregnant with rich truth, that "the Gods in the beginning divided Man into men that he might be more helpful to himself, just as the hand was divided into fingers the better to answer its end." In our day Man has been broken into smaller pieces than ever before to make the men of the generation, a process which has been carried further in Germany perhaps than anywhere else. We have specialists instead of Man specializing. We have scientists instead of Man investigating nature. We go much further than that; we have the geologist, the biologist, the entomologist instead of Man intensely studying earth formations, living things, insects. Instead of having the mere specialist of a particular sort we should have Man investigating nature, having special tools to be sure and confining attention to a particular range of subject matter not too vast for him, but pre-eminently Man. The individual, in order to possess himself and to orient his work in the general activity of mankind, "must sometimes return from his own labor to embrace all other laborers." Man should not be so minutely divided and peddled out as to be spilled into drops that can not be gathered up again.

The more universal is the character of the national temperament the more difficult it is to single out its peculiar traits. Striking characteristics are more readily recognized than highly developed features of central importance. Whether from this fact or from some other it is not so easy to determine the characteristics of French thought as of British or German, when one confines his attention to the present generation of thinkers. But if one looks into the history of the past century he will have no occasion of doubt as to the way in which the scientific spirit has manifested itself in France. Its flower can be easily recognized to-day in the elegance and finish, sense of proportion and importance, careful emphasis of the greater matters, which are characteristic of the work of the French. Intimately connected with this and interacting with it to the advantage of both is the fact that France has done more than other countries to popularize science—a thing which must be recognized as affording a very valuable and powerful stimulus to the growth of the scientific spirit.

In the first decades of the last century the home of the scientific spirit was in France. Paris was the capital of the republic of exact truth. Interest in scientific discovery and creation was widespread among her people. The spirit of literature flourished alongside the spirit of exact researches and both found place in the same creative intellect. Out of this union of elements, too much separated in other countries, there grew up a tradition of literary excellence in scientific exposition which abides to the present and contributes in no small way to the comfort and delight which

every one must feel in reading a French scientific book or memoir.

The profound use of analytical methods and the reduction of scientific truth to rigorous yet pleasing mathematical form is characteristic of the French. The mechanical view of nature arose among them. They were the first to set out to see how far science and reasoning can go while disregarding the principle of individuality. Among them science first became "truly conscious of its true methods, its usefulness, its most becoming style, its inherent dignity, its past errors, its present triumphs, the endless career which lies before it, and the limits which it can not transgress."

Of the three countries which have led in scientific development it seems to be the impartial verdict of history that we owe to France the largest number of works perfect in form and substance and classical for all time; that the greatest bulk of scientific work, at least in more recent decades, has been produced in Germany; but that the new ideas which have fructified science, in earlier times and also in the nineteenth century, have arisen more frequently in Great Britain than in any other country.

Science is cosmopolitan and flourishes under many skies. But the spirit of scientific work is national. Each great people manifest their own characteristics. They develop truth by methods influenced by the peculiar bias native to their temperament and institutions. No prime contributions to knowledge have ever been made repeatedly through a long period of time by any people other than those who labored from a center situated at the heart of their life and social organization. The deep-lying unknown things in nature can be found out only by one who looks upon her with eyes of his own. A people who seek guidance outside of themselves will never be led in the paths of high achievement. Only during their minority can they afford to lean upon the strength of others more powerful than they. On coming of age it is indispensable that they shall work from a center of their own.

American science should now begin to render to the science of other countries a measure of support commensurate with that which it receives in turn in the mutual cooperation of all in the discovery of truth.

Up to the present we in America have not developed either a national spirit or a national tradition in scientific investigation. Research was not native to our soil and was not introduced by the first settlers. Along with the other portions of our European civilization our scientific attitude has come to us by inheritance. But we have now come to the time when American scientists may begin to proceed from an intellectual center of their own and make contributions in a characteristic spirit to the intellectual worth of mankind.

R. D. CARMICHAEL
UNIVERSITY OF ILLINOIS

SCIENTIFIC EVENTS

THE PROPOSED NEW CHALLENGER EXPEDITION

Nature announces that the council of the British Association has reluctantly decided that the organization of a new *Challenger* expedition, such as was suggested by Professor W. A. Herdman in his presidential address to the association at Cardiff last August, on an adequate scale can not be profitably promoted at the present time.

In accordance with the resolution passed by the general committee at the Cardiff meeting, the council appointed a special oceanographic committee to inquire into the details of the suggested project and to prepare a reasoned statement as to the need for such an expedition and its probable scale, scope, equipment, and cost. This memorandum has now been completed, and is available for use when the occasion arises; but in view of the present demand for economy in all national expenditure, and after consultation with trustworthy authorities, both scientific and administrative, the council at a recent meeting adopted a report by the general officers to the effect that, while retaining the scheme under consideration, no further action should be taken until circumstances seem more favorable for public expenditure upon such an undertaking.

The oceanographic committee will remain in existence with a watching and organizing brief ready to revive the project whenever a favorable opportunity arises, and the council will doubtless report upon the whole matter to the meeting of the general committee of the association at Edinburgh next September. It is hoped that the proposed expedition is postponed only for a season, and that the interval may be usefully employed in perfecting plans and making other essential preparations.

THE NOLAN PATENT OFFICE BILL

The American Engineering Council of the Federated American Engineering Societies will seek at the opening of the special session of Congress to have the Nolan Patent Office Bill passed.

Failure of the measure in the last session is attributed to the presence of the Federal Trade Commission section which Edwin J. Prindle, of New York, chairman of the American Engineering Council's Patents Committee in a report to L. W. Wallace, executive secretary of the council, asserts should not be enacted into law in any form even as a separate bill. The committee reports:

> The bill for the imperatively necessary relief of the Patent Office, after passing the House of Representatives with satisfactory provisions for the Patent Office, failed to pass the Senate at the session just closed with those same provisions, solely because of the presence in it of an unrelated section known as the Federal Trade Commission Section.
>
> The former opposition in the Senate to the Patent Office relief and that which forced the unacceptable reductions in salaries and numbers of examiners and clerks (which the Conference Committee was persuaded to set aside) is largely and seemingly almost wholly overcome. But the opposition in the Senate to the Federal Trade Section is determined and has expressed an intention to prevent the Patent Office from getting the desired relief unless the Federal Trade Section is removed from the bill.
>
> More than preventing the Patent Office relief, however, the Federal Trade Section is believed to be a dangerous measure in itself. It provides that the Federal Trade Commission may receive assignments of and administer inventions and patents from governmental employees and is an entering wedge for further legislation to empower the Trade Commission to receive patents from non-governmental inventors or owners.
>
> An exclusive license would have to be granted, at least for a few years, to induce any one to undertake the almost always necessary development expense, and the Trade Commission would surely be charged with favoritism in granting such a license. In order to protect its licensees, the Trade Commission would have to sue infringers, a most unfortunate activity for the government. The industries would close their doors to the government employees fearing to disclose to them their secrets or unpatented inventions, and research by the industries would be discouraged for fear that government employees, using government facilities, might reach the result first and patent it.

THE AMERICAN PHILOSOPHICAL SOCIETY

The American Philosophical Society will hold its general meeting in the hall of the society on Independence Square on April 21, 22 and 23. The program includes the following discussions:

The Application of the Method of the Interferometer to certain Astronomical Researches:

- To astrophysical problems: Henry Norris Russell, Ph.D., professor of astronomy, Princeton University.
- To the measurement of double stars: Frank Schlesinger, Ph.D., director, Yale University Observatory.
- To the determination of stellar parallaxes: John A. Miller, Ph.D., director, Sproul Observatory, Swarthmore, Pa.

Atomic structure:

- David Webster, professor of physics, Leland Stanford University.
- William Duane, director of radium institute, Harvard Medical School, Boston.
- Bergen Davis, professor of physics, Columbia University.

On Friday evening there will be a reception in the hall of the Historical Society of Pennsylvania, when Dr. James H. Breasted, professor of Egyptology and Oriental history, University of Chicago, will speak on "Following the trail of our earliest ancestors" illustrated by lantern slides.

Award will be made of the society's Henry M. Phillips Prize of two thousand dollars for

the best essay on, "The control of the foreign relations of the United States: the relative rights, duties and responsibilities of the President, the Senate and the House, and of the judiciary, in theory and practise," and presentation of John Scott Medals "For Useful Inventions," by Owen Roberts, Esq., on behalf of the Board of City Trusts of Philadelphia.

SCIENTIFIC NOTES AND NEWS

The National Institute of Social Sciences has awarded its gold medal to Mme. Curie.

Mr. Herbert C. Hoover has been elected a trustee of the Carnegie Institution of Washington.

Professor A. S. Eddington has been elected president of the Royal Astronomical Society in succession to Professor A. Fowler.

Mr. C. Tate Regan has been appointed keeper of zoology at the British Natural History Museum, South Kensington.

Dr. Johan Hjort, director of the Norwegian Fisheries, has received the degree of doctor of science from the University of Cambridge.

We learn from *Nature* that the following were elected fellows of the Royal Society of Edinburgh at the ordinary meeting on March 7: Dr. Nelson Annandale, Mr. W. Arthur, Mr. B. B. Baker, Dr. Archibald Barr, Mr. J. Bartholomew, Mr. A. Bruce, Mr. Andrew Campbell, Dr. Rasik Lal Datta, Dr. John Dougall, Dr. C. V. Drysdale, Mr. G. T. Forrest, Dr. W. Gibson, Dr. J. W. H. Harrison, Mr. J. A. G. Lamb, the Rev. A. E. Laurie, Mr. Neil M'Arthur, Mr. D. B. M'Quistan, Dr. T. M. MacRobert, Dr. J. M'Whan, Mr. J. Mathieson, Sir G. H. Pollard, Professor E. B. Ross, the Right Hon. J. P. Smith, Professor N. K. Smith, and Dr. I. S. Stewart.

At the Chicago meeting of the American Association for the Advancement of Science, the council established a committee on conservation to cooperate with similar committees of other organizations. This new committee on conservation has now been appointed, its personnel being as follows: J. C. Merriam, *chairman*, Carnegie Institution of Washington, Washington, D. C.; Isaiah Bowman, American Geographical Society, New York City; H. S. Graves, 1731 H Street, N.W., Washington, D. C.; Barrington Moore, 925 Park Avenue, New York City; V. E. Shelford, University of Illinois, Urbana, Ill.

Dr. Haven Emerson, formerly commissioner of health of New York City, has been appointed medical adviser and assistant director of the Bureau of War Risk Insurance.

Dr. P. G. Nutting, organizer and for the past four years director of the scientific research of the Westinghouse Electric Company, will not be with that company after May 1. Dr. Nutting was for ten years with the Bureau of Standards, leaving in 1912 to assist Dr. Mees in the organization and development of the research work of the Eastman Kodak Company.

Dr. L. A. Mikeska has resigned from the Color Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture, to join the staff of the Rockefeller Institute for Medical Research, New York City.

Dr. Henry E. Crampton, of Barnard College and the American Museum of Natural History, has returned from a nine months' trip to the tropics and the islands in the Pacific.

John W. Gilmore, professor of agronomy at the University of California, has been appointed exchange professor from the United States to the University of Chile for the academic year 1921–1922.

Dr. Lafayette B. Mendel, professor of physiological chemistry, Yale University, spoke before 500 members of the Chicago Section of the American Chemical Society on Friday, March 18. Preceding the talk, a dinner in honor of Dr. Mendel was served at the Quadrangle Club, University of Chicago.

On March 12, the Mayo Foundation, Rochester, Minn., was addressed by Dr. James Ewing, President George E. Vincent and Dr. Charles Choyce.

Professor Douglas Johnson, of Columbia University, addressed the annual open meeting of the Syracuse University chapter of Sigma Xi, March 16, on "The rôle of geography in world affairs." On March 17, he spoke at Colgate University on the same subject.

The Council of the Paris Faculty of Medicine, has received a gift of 50,000 francs from Mme. Mathias Duval, widow of the eminent professor of histology. The sum having been given without any conditions as to the manner in which it shall be expended, a committee has been appointed to decide how it can best be employed.

Plans to broaden the scope of the Gorgas Memorial Institute in Panama into a research and teaching institution of international scope are being developed by the provisional board of directors for the United States.

Ernest Joseph Lederle, the sanitary engineer, died on March 7, at the age of fifty-six years. Dr. Lederle was health commissioner of New York City under Mayor Low and Mayor Gaynor.

UNIVERSITY AND EDUCATIONAL NEWS

The latest report on the Worcester Polytechnic Institute Endowment Fund indicates pledges of over $900,000 to date. The committee in charge has no doubt that the entire $1,000,000 will be pledged before Commencement Day. This is the second million of the $2,000,000 fund undertaken, the first million having already been pledged, partly in the form of scholarship funds given by industrial corporations in Worcester.

An appropriation by the Oregon legislature of $271,000 has been made for medical work in Portland by the University of Oregon.

The corporation of Yale University has adopted regulations with reference to research associates and research fellows. Research associates are to have professorial rank, and research fellows assistant professorial rank. The titles are to be given to men of distinguished attainments who devote most of their time to research rather than to teaching. It was voted "That the title of research associate should be confined to men of real distinction in research and productive scholarship, and that it should carry with it inclusion in the list of 'Professors and other officers of professorial rank,' the object of the position being to attract to the university men of eminence, who usually wish greater freedom in the use of their time for research than professorial appointments permit."

Eugene E. Haskill, S.E., dean of the combined colleges of civil and mechanical engineering at Cornell University has resigned. His resignation is to take effect in June of this year after his sabbatic leave, which he is now enjoying. Dean Haskill has been at the head of the college of civil engineering at Cornell since 1905, prior to which he was in charge of the United States geodetic survey of the Great Lakes. Dean Haskill is a graduate of Cornell University, class of 1879; his successor, Professor F. A. Barnes, is also a Cornell graduate, having been granted his degree in 1897.

Dr. Paul Weatherwax, for the past two years associate professor of botany in the University of Georgia, has resigned to accept an associate professorship in Indiana University, where he was formerly instructor.

Professor Irving H. Cameron, for many years professor of surgery in the medical department of the University of Toronto, has relinquished that chair, and Dr. Alexander Primrose has been appointed to succeed him temporarily.

DISCUSSION AND CORRESPONDENCE

ARE THE LANCE AND FORT UNION FORMATIONS OF MESOZOIC TIME?[1]

To the Editor of Science: Under the above title Professor Charles Schuchert has recently reviewed in Science (issue of January 14) a

[1] Published with the permission of the director of the U. S. Geological Survey.

publication of the Geological Survey by Dr. T. W. Stanton on "The Fauna of the Cannonball Marine Member of the Lance Formation." Following the review Profesor Schuchert announces his opinion that the evidence

> binds invertebrate paleontologists and geologists together in the conviction that the Lance and the Fort Union are of Mesozoic time. The U. S. Geological Survey should now reverse its former conclusion and adapt itself to the fuller evidence.

In the first conclusion Professor Schuchert adopts the view of Dr. Stanton and of Messrs. Lloyd and Hares, who described and named the Cannonball beds in 1915, as to the Lance formation, but goes even further than they do in assigning the Fort Union to the Mesozoic. However, it does seem difficult to justify a separation of these formations, making one Cretaceous and the other Eocene.

As a geologist long interested in the Cretaceous-Eocene problem of the Rocky Mountain region, I wish to comment that Professor Schuchert is not warranted in assuming to speak for geologists inasmuch as he does not regard much of the geological evidence. Nor does he give due weight to paleontological data, aside from those of the mollusca. Moreover, it seems gratuitous to assume that the Geological Survey, because it has not adopted the conclusion reached by Professor Schuchert, has not considered in its decisions the bearing of facts concerning the Lance secured by its own investigators some years ago. The Survey geologists have also secured much other evidence.

Now it is perfectly well known to Professor Schuchert that the question as to the age of the Lance and Fort Union beds is a part of a very large problem, involving a conception of the geologic evolution of the whole Rocky Mountain Province from Mexico to far north in Canada. More than a score of more or less local formations, younger than the great continuous Cretaceous section and older than the Wasatch Eocene, are to be correlated and interpreted. These formations present a great deal of varied evidence as to the history of the Cretaceous-Eocene transition period. The Survey has, in fact, based its action, with which Professor Schuchert disagrees, on a consideration of all available evidence.

Investigations of the Rocky Mountain Province and adjacent lower country to east and west, made within 30 years past, have surely proved that the older idea of the diastrophism which characterized the transition from the Cretaceous to the Eocene period was very faulty. The change was gradual, not abrupt, and, while over a large area the great Cretaceous succession was ended, the uplift was epeirogenic for a long period during which erosion and prevailingly continental deposition proceeded, and there was no such abrupt environmental change affecting life upon the land as has been assumed. In general the newer picture of Rocky Mountain development, after Laramie time, gives no basis for the belief that dinosaurs and some other dominantly Mesozoic land forms could not survive into the Eocene. In fact, dinosaurs of the type found in the Lance lived in the Denver epoch, that is, they survived during the period in which the entire Cretaceous section was removed from a large part of Colorado and adjacent regions.

The Lance and Fort Union formations of eastern Montana and adjacent portions of the Dakotas present an exceptionally interesting and important association of stratigraphic and paleontologic data, the subject of conflicting ideas which must eventually be harmonized. Their correct interpretation will contribute much to our understanding of Rocky Mountain history. The most striking data will be briefly specified.

The Lance in some places rests with erosional unconformity on the Fox Hills Cretaceous, the gap being of undemonstrated extent. It may be large, and not small, as Schuchert assumes. In some districts Lance and Fort Union form an apparently continuous section reaching 5,000 or more feet in thickness. In one limited area only, the Ludlow lignitic and Cannonball marine shale members are seen to separate the formations.

A well defined flora runs through both Lance and Fort Union. It is considered

clearly Eocene by Knowlton. This view was not seriously opposed until the flora, first found in the Fort Union, was traced down through the Lance almost to its base. The flora thereby lost much of its interest to vertebrate and invertebrate paleontologists, but not to paleobotanists or geologists.

The Fort Union beds have a mammalian fauna of small forms considered to prove the Eocene age of the strata containing them until allied types were found in the Lance associated with dinosaurs and other supposed Cretaceous forms. The significance of the poor little mammals has seemed to disappear, from certain standpoints, but not from all. The Ceratops fauna of the Lance is closely similar to that of the Denver beds, correlated by the Geological Survey, together with other Colorado and New Mexico formations, with the early Eocene beds of the Gulf region.

The Cannonball shales demonstrate the temporary return of marine waters from an unknown and as yet undiscussed region to the Dakota district, after an absence which was of considerable duration. Where was this sea meanwhile? The known Cannonball fauna consists of two sharks, several corals and foraminifera, all of which range into the Tertiary, and 60 molluscan species. The molluscan group, according to Stanton, has "the general aspect of a Tertiary fauna," but he considers 24 species to be identical with forms in the Fox Hills or Pierre formations of the Cretaceous nearby, while not one is identical with any known form in the lowest Eocene of the Gulf region and 35 are new species.

Dr. Stanton has given, in the excellent publication reviewed by Professor Schuchert, a careful description of the Cannonball fauna and discussed its relationships to Cretaceous and Gulf Eocene faunas. Elsewhere he has discussed the age of the Lance on general grounds but he has always given the greatest weight to the character of the invertebrate fauna, as is natural considering his special point of view.

Professor Schuchert has gained wide reputation for his broad studies in paleogeography. His mature opinion was no doubt expressed in his "Text-book of Geology," (1915, p. 581) where he says:

> It is, therefore, the principles of diastrophism and paleogeography that will eventually correctly define the periods or systems.

It may seem at first thought that this principle guided Professor Schuchert in his opinion that two paleogeographic maps presented by Stanton "are a most striking summation of the problem in hand . . . ." That judgment seems, to the writer, far from the truth.

One of these maps (after Schuchert) represents the Pierre Cretaceous ocean as extending from the Gulf of Mexico through the Rocky Mountain region far toward the Arctic, with a land barrier reaching from the east at least to the boundary of Colorado and New Mexico. This barrier may have extended further. The other map shows the supposed early Eocene limits of the Gulf sea and the geographic position of the Cannonball area. What is needed is a paleogeographic map, or several of them, to express a reasonable hypothesis of the course of retreat of the sea as the land barrier rose and apparently cut off entirely a restricted northern ocean from the Gulf sea, perhaps before Fox Hills time. Somewhere there was an open sea, insisted on by Dr. Stanton, cut off from the Atlantic-Gulf ocean, in which the Fox Hills fauna was modified to that found in the Cannonball.

Unfortunately Dr. Stanton does not discuss the origin, the position, the extent, or the climatic and other conditions of the open sea in which this modification took place. He considers that the Fox Hills is the approximate equivalent of the upper part of the *Exogyra costata* zone, which is near the upper limit of the Cretaceous in the Atlantic-Gulf region. He nevertheless recognizes "considerable differences" in the faunas, which he attributes to lithologic facies, geographic separation, and possibly to climate.

It seems to a geologist necessary for the

invertebrate paleontologist to give some attention to the possibility that a northern isolated sea existed into early Eocene time and that its conditions produced a modification of the Cretaceous molluscan fauna naturally different from that arising during the same time in the Gulf region. Does not the Cannonball fauna show what modification had been reached at a time which, under the existing conditions, must be placed in the general time scale by utilizing, instead of ignoring, the other facts of the Lance and Fort Union formations, and also the concordant knowledge of Rocky Mountain history?

Whitman Cross

Washington, D. C.,

To the Editor of Science: In Science for January 14, 1921, Professor Schuchert, in reviewing Dr. Stanton's recent paper on "The fauna of the Cannonball marine member of the Lance formation," proceeds to answer this query in a most emphatic and unreserved affirmative. He assumes to speak with authority for geologists and vertebrate and invertebrate paleontologists, but he admits that the "floral brethren" will, of course, continue to dissent. The problem of establishing the line between Cretaceous and Tertiary time in the Rocky Mountain province has been more or less of a storm center for a number of years, but the question can only be settled when all the available lines of evidence have been evaluated and harmonized. Drawing this line at the top of the Fort Union will profoundly affect other areas and other problems, many of which Professor Schuchert appears to have underestimated if not indeed overlooked.

The faith that is in the "floral brethren" is strong! This evidence has been set forth at length on several occasions, but a brief recapitulation may not be without interest. Up to the present time, with one or two minor exceptions, the Fort Union has been everywhere accepted as of Eocene age. It has a very large flora of approximately 500 species. Aside from local stratigraphic and paleontologic considerations, the Eocene age of the Fort Union flora is attested by its affiliation with many European Eocene deposits of definite, acknowledged position, as Ardtun in Mull, Gelinden in Belgium, and Sezanne in the Paris Basin, as well as the Eocene in Greenland and Alaska. This affiliation amounts to many identical and closely related species, as well as identical and related genera. Several Fort Union species are believed to be still living, a condition not known for any earlier American deposit.

The flora of the Lance formation is also a rich one, comprising about 125 forms, some of which, however, are so fragmentary and obscure as to be incapable of more than generic determination. After eliminating the new forms and those that can not be specifically named there are 87 species that are positively identified, all but 15 of which (about 80 per cent.) are found in the Fort Union. It is unmistakably a Fort Union flora, and occurs through the whole vertical range of the Lance formation, some of the most characteristic Fort Union plants being found within four feet of the base of the beds. Of the entire known Lance-Fort Union flora less than 15 species have been reported from Cretaceous beds anywhere, and this number will be reduced instead of enlarged by revision of the floras involved.

Sedimentation was undoubtedly continuous through the Lance and Fort Union formations; in fact, it is impossible to draw any satisfactory line between them. The highest point at which dinosaurs occur is taken as the top of the Lance, but where these remains are absent it has no recognized or recognizable top. If the Cannonball marine member of the Lance formation is Cretaceous then both Lance and Fort Union are Cretaceous, for there is no stopping point short of the top of the Fort Union. Professor Schuchert even holds that there "is here a continuous and unbroken series of deposits from the Pierre and Fox Hills into the top of the Fort Union, and that the reported erosion contacts between the several formations are due to nothing more than changes from marine to brackish and fresh-water deposition, or to irregularities

characteristic of continental sediments, the local breaks not representing a loss of geologic time of any marked historical value."

The plants certainly do not uphold this contention, but they do indicate a very considerable hiatus between the top of the acknowledged marine Cretaceous section and the inauguration of the Lance. The Laramie is not known within this area, but can it be doubted that it was the interval during which in other areas beds of Laramie age were laid down and subsequently removed in whole or in part? That there was an important interval of some kind is also shown by the fact that it was sufficiently long for over 60 per cent. of the marine Cannonball fauna to be derived through modification of the typical Fox Hills fauna.

F. H. Knowlton

PROOF OF NON-DISJUNCTION FOR THE FOURTH CHROMOSOME OF DROSOPHILA MELANOGASTER

During the spring and summer of 1920 I secured genetic evidence that strains of *D. melanogaster* haploid for the fourth chromosome had been produced by non-disjunction, and in November cytological verification was obtained. The fact that non-disjunction of the fourth chromosome is known to occur is perhaps the strongest reason for believeing that the aberrations observed by Dr. Little[1] may be the consequences of non-disjunction. The direct evidence presented by Dr. Little by no means proves such to be the case, which is unfortunate, considering the ample means in *D. melanogaster* for checking up this hypothesis by means of other fourth-chromosome mutants (bent, shaven) and especially by direct cytological examination. Probably Dr. Little will include such evidence in his forthcoming detailed report. For the present, his published evidence is in better conformity with the assumption of a less extreme eyeless allelomorph, or of a dominant fourth-chromosome "minus" modifier. On the non-disjunctional view selective reduction of the three fourth chromosomes present is required, but there is no obvious reason why E and e should always go together in the manner assumed. A simple explanation is supplied on the weak-allelomorph view, for Ee is the weak allelomorph and the selective reduction Ee — e is simply *segregation* in the e^w — e compound. *Linkage* supplies the explanation on the modifier view, for the E is then a dominant minus modifier in the fourth chromosome, and Ee — e is simply M^ee — e. As far as can be judged from the short account given, all the observed ratios are in conformity with either of these views. Thus, Dr. Little has not proved by direct and available means that the case is actually one of non-disjunction, nor has he proved it negatively by excluding well-recognized alternative hypotheses which are equally valid and even more in harmony with the facts of the case as stated.

C. B. Bridges

[1] Science, 53: 167.

SURVEYING FROM THE AIR

The article on "Surveying from the Air," December 17, 1920, is a summary of the work of the Coast and Geodetic Survey along the lines of aerial photography, and of necessity does not go into the requisite detail regarding the reasons for making the following statement:

> These experiments proved very conclusively that photographs from the air, using present-day equipment, are of little practical value to the hydrographer.

This statement has been noted by Mr. Willis T. Lee, of the U. S. Geological Survey in Science, February 18, 1921, who cites *Comptes Rendus* Tome 169, October 27, 1919, in which mention is made of experiments near Brest where successful photographs were obtained of the bottom at a maximum depth of 17 meters.

During the experiments at Key West, the results of which were the only ones then known to me, occasional successful photographs of the bottom were obtained in depths of 35 feet and less. No attempt was made to photograph at greater depths. When the conclusion regarding the "practical value" of the photographs was arrived at, all factors re-

garding their use for hydrographic purposes were considered. Obviously, a comparison was made with the present-day methods of hydrographic surveying.

It may be argued that aerial photography is more rapid, because a photograph of more than one square mile is made in a fraction of a second, and a strip 70 miles long and over a mile wide can be photographed in an hour. There are several problems to be overcome by both the aviator and the hydrographer before this can be done. Weather conditions along the sea coast are not as suitable for aerial photography as might be expected. Let us see how the photographs as made by the French would apply to our waters. These photographs were made under the following conditions: Focal plane horizontal; altitude, 2,600 meters; at time of low water; the sun high above the horizon; calm sea. Along the coast of the United States, a calm day is generally hazy, so much so that it is impossible to make photographs from an altitude of even 4,000 feet without special treatment of plates or films. We are aware of recent experiments regarding the penetration of haze, but at the time the Key West experiments were made, little was known of this new process. Further developments may make it possible to penetrate haze at altitudes of 2,600 meters. But disregarding haze, those days that are calm and cloudless are infrequent. It is difficult to obtain data regarding meteorological conditions as affecting aerial photography along the coast, but from available data, it is ventured that about one day a month would fulfill conditions as called for by the French, and that is believed to be an optimistic estimate.

Regarding control for the photographs, very few places along our coast are as ideally fitted for control of aerial protographs as the area chosen near Brest. This locality is dotted with numerous small islets, and ample control could be obtained for each photograph. At Key West, it was necessary to use boats as control points, so that the speed at which an area was covered was limited to the speed of the vessels. There are a few places along our coast where enough land stations would appear for control, but these areas are generally in bays or rivers where water is not clear enough for good photographic work. Buoys or rafts may be used as control points, but the cost and labor of handling them would be excessive. A raft about 10 feet in diameter would be needed in order to be legible on a 1:10,000 scale photograph. The problem of handling a large number of these floating signals would require a good sized vessel and crew.

The uncertainty of results is another factor. The French have solved some of the problems by using the stereoscope, so that the confusion, brought about by vari-colored bottom of uniform depth, is partly eliminated. Some shoals will show clearly, while others close by do not appear in the photograph, probably due to a difference in color or lighting. The photographs will not record all shoals as seen by the aviator. It is often necessary to fly over the same area repeatedly in order to obtain good results.

Unless ideal conditions prevail, the cost of an aerial survey with present-day equipment, will far exceed that of a wire drag survey, and will not give as certain results. We believe that aerial photo-hydrography is of some use in a few limited locations, and there are possibilities of future development, but at the present date, revision work by photographs on land holds forth greater promise, and is one in which more certain results can be obtained.

It may be of interest to quote a sentence from a letter dated January 10, 1921, from Le Directeur du Service Hydrographique addressed to the Director of the Coast and Geodetic Survey, in which the following statement is made regarding aerial photography along the coast of Syria in 1920.

> Les circonstances n'ont d'ailleurs pas permis de l'employer systematiquement. (The circumstances do not, however, permit of its systematic use).

A careful analysis of the conclusion reached in the article "Surveying from the Air," especially of the qualifying words "using present-day equipment," and "little practical value,"

will probably derive the result that the statement is not as hastily worded as it was first thought to be.

E. Lester Jones

SCIENTIFIC BOOKS

Physics of the Air. By W. J. Humphreys, C.E., Ph.D., Professor U. S. Weather Bureau, Philadelphia. Published for the Franklin Institute by J. B. Lippincott Co., 1920.

Professor Humphreys states in his introduction that "it is obvious that an orderly assemblage of all those facts and theories that together might be called the *Physics of the Air,* would be exceedingly helpful to the student of atmospherics."

Of this there can be no doubt, and the author has rendered a great service by thus bringing together and making easily available material that otherwise would have remained scattered through technical magazines, official publications like the *Monthly Weather Review* and journals of organizations like the Royal Meteorological Society.

The volume had its inception in a series of lectures delivered by Dr. Humphreys at the San Diego Aviation School in 1914. These lectures revised and printed from month to month in the *Journal of the Franklin Institute,* 1917, 1918, 1919 and 1920, are now consolidated in one volume.

As late as 1917 our military authorities failed to appreciate the importance of a knowledge of aerography, that is, the structure of the atmosphere. In June of that year a high officer of the Signal Corps, at that time entrusted with aviation, wrote:

> It has frequently happened in the past that men who might otherwise have made good pilots became so alarmed in advance over the subject of "holes in the air" and so impressed with the terrible dangers of aerial navigation, that they never succeeded in gaining the necessary confidence to become good pilots, etc.

This was given as a valid reason for refusing to utilize recent advances in meteorology! And again:

> So little time is available and so great the necessity for extreme haste in preparing aviators for service overseas that there is no opportunity to give more than the elements of meteorology in one or two lectures.

These views are referred to here, simply to show in some measure the amount of official inertia which had to be overcome. After many promising lives had been sacrificed, the need of the fullest knowledge possible was manifest; and before the war ended aerography had come into its own in both army and navy schools of instruction.

Professor Humphreys divides his treatise into four main parts; mechanics and thermodynamics; atmospheric electricity and auroras; atmospheric optics; and factors of climatic control. The author had the great advantage of access to the Weather Bureau Library, and critical readings by his colleagues. Furthermore, the text appeared in type before final publication. The work is unusually free from typographical errors.

There are a few slips, however. On page 49 the symbol for temperature of the isothermal region T might with advantage have been placed in front of the radical, or at least in some way separated more than at present. Again, it would be a gain if instead of saying that the temperature of a black radiator, in this case the earth, was 259° C. absolute, the author had used the more common form 259° A., adding if he thought it necessary, in degrees C. It is desirable in a text-book to avoid confusion, by using consistent notation. The reviewer holds that it is not good form to speak of a given temperature as *259° C. absolute* on one page and on the next page give a diagram expressing the same value in degrees Centigrade, that is, —14° C. One may expect to meet a slip from such loose practise and sure enough it occurs. On pages 75 and 76 it is stated:

> The effective absolute temperature of the earth as a full radiator is approximately 260° C.

Rather a warm condition; but of course the author means that the effective temperature on a certain approximate absolute scale is

260°. There is a scale which might have been advantageously used here, namely the Kelvin-Kilograde scale. True, few are as yet familiar with it; but the colors should always be in advance of the line, not abreast nor yet behind. In an up-to-date scientific book we have the right to expect leadership rather than tolerance.

The airman has got to forget the unscientific, arbitrary scales of his fathers; and stop using inches, minus signs, etc. His range of temperature is from summer day surface values to winter sub-polar readings near the stratosphere; and old-fashioned methods are inadequate.

Pressures are generally given in this book in millimeters of mercury with occasional lapses into inches. In a treatise dated 1920, one might look for pressure values throughout in units of force, that is, dynes or kilodynes per square centimeter.

In the chapter on "Atmospheric Circulation" which is well put, and more clearly explains the mechanics of deflection than most other text-books, it is demonstrated that in the case of a wind with a velocity of 22 meters per second, there will be a modification of velocity, depending upon whether the wind is blowing east or west; that is, a given mass weighs less going east than going west. A note might have been added giving results of recent gravity determinations at sea on fast-moving (22-knot) destroyers (25-mile-per-hour vessels); in which it was definitely ascertained that the barometric pressure changed 0.1 kilobar (0.075 mm.) when the course was reversed. Going east with the earth the centripetal force is greater than when steaming west. All this is of importance in connection with fast-moving airships.[1]

The discussion of change of velocity with latitude, deflective effect of the earth's rotation, relative values of centrifugal and rotational components, and gradient winds, is thorough and well expressed. Of course, the explanation of friction acting as the effective damping factor against high rotational winds is no longer tenable; and there is not sufficient emphasis laid on the fact that the high rotative values are hypothetical, not real so far as mobile air is involved.

[1] See SCIENCE, February 6, 1920; also January 9, 1920.

Chapter XI., on "Winds Adverse to Aviation," explains the so-called "holes in the air," "bumps," "dunts," etc. There is not a mathematical symbol in the whole chapter. The different phenomena are explained in straightforward, simple language. However, there is much yet to be learned in connection with favorable and adverse conditions; and we await some Maury who will do with the logs of airships what the old Commodore did with the logs of the clippers of his day.

Chapter XIV. contains many photographs of cloud forms, but neither here nor in the first chapter where many instruments are given, is mention made of a nephoscope. Fair credit for cloud work done at Blue Hill Observatory is not given; nor is mention made of Professor Bigelow's International Cloud Report.

Chapter XV., on "The Thunderstorm" has 105 pages, and yet is not included in Part II., dealing with Atmospheric Electricity and Auroras, which has only 18 pages.

Part III., on "Atmospheric Optics," has 129 pages and is based largely on the well-known Pernter-Exner "Meteorologische Optik" and Mascart's "Traité d'Optique."

Part IV., 74 pages, deals with factors of climatic control, that is, in the author's words, a discussion of the physics of climate and not of its geographic distribution. The chief factors considered are latitude, brightness of the moon and planets, solar constant, solar distance, obliquity of ecliptic, perihelion phase, extent and composition of the atmosphere, vulcanism, sun spots, land elevation, land and water distribution, atmospheric circulation, ocean circulation, and surface covering.

Elaborate tables of gradient wind velocities are given in the appendix. We notice a few minor typographical errors. On page 136, latitude 10°, the change of direction is 2°.61 not 261, and the heading needs revising on page 162, m.m. should be mm.; on page 221, figure 31 should be 32; and on page 227, figure

57, the lengend should give the elevation of the station.

ALEXANDER MCADIE

REPORT OF THE COMMITTEE ON NOMENCLATURE OF THE BOTANICAL SOCIETY OF AMERICA

At the Baltimore meeting of the Botanical Society of America (1918), the Committee on Generic Types presented a set of rules for fixing the types of genera. The report was published in SCIENCE (49: 333–336. 1919). At the same meeting the committee was enlarged to nine members and made a standing committee on botanical nomenclature, with authority to prepare a code of nomenclature. The standing committee consists of LeRoy Abrams, N. L. Britton, E. A. Burtt, A. W. Evans, J. M. Greenman, A. S. Hitchcock, M. A. Howe, C. L. Shear and Witmer Stone. The actual work of elaborating a code was done chiefly by a subcommittee consisting of J. C. Arthur, J. H. Barnhart, R. S. Breed, N. L. Britton, O. F. Cook, F. V. Coville, A. W. Evans, B. Fink, A. S. Hitchcock, M. A. Howe, F. H. Knowlton, P. L. Ricker, C. L. Shear and H. C. Skeels. The following code was presented by the committee:

A TYPE-BASIS CODE OF BOTANICAL NOMENCLATURE

PRINCIPLES

1. The primary object of formal nomenclature in systematic biology is to secure stability, uniformity, and convenience in the designation of plants and animals.

2. Botanical nomenclature is treated as beginning with the general application of binomial names to plants (Linnæus' "Species Plantarum," 1753).

3. Priority of publication is a fundamental principle of botanical nomenclature. Two groups of the same category can not bear the same name.

Note a.—This principle applies primarily to genera and species.

Note b.—Previous use of a name in zoology does not preclude its use in botany; but the proposal of such a name should be avoided.

4. The application of names is determined by means of nomenclatural types.

Note.—A generic name is always so applied as to include its type species; a specific name is always so applied as to include its type specimen.

Rules and Recommendations

Section 1. Publication of Names

Article 1. A specific name is published when it has been printed and distributed with a description, or with a reference to a previously published description.

Note.—A recognizable figure may be the equivalent of a description in the literature of paleobotany and diatoms.

(*a*) In the transfer of a species from one genus to another, the original specific name is retained, unless the resulting binomial has been previously published.

Recommendations: Botanists will do well, in publishing:

1. In describing parasitic fungi to indicate the host and to designate the name of the host by its scientific Latin name.

2. To give the etymology of all new generic names.

Article 2. A generic name is published when it has been printed and distributed

(*a*) With a generic or specific description (or a recognizable figure, see Art. 1, note) and a binomial specific name,

(*b*) With a generic and specific name and the citation of a previously published description,

(*c*) With a definite reference to at least one previously published binomial.

Note a.—A name is not published by its citation in synonymy, nor by incidental mention. Such a name may be taken up but not to replace one already properly published.

Note b.—Of names published in the same work and at the same time, those having precedence of position are to be regarded as having priority.

Recommendation: Botanists will do well, in publishing, to give the etymology of specific names when their meaning is not obvious.

Section 2. Application of Names

Article 3. The nomenclatural type of a species is the specimen or the most important of the specimens upon which its original published description was based.

(*a*) If only one specimen is cited, that is the type.

(*b*) If one specimen is designated as the type, that specimen shall be so accepted, unless an error can be demonstrated.

(*c*) A species transferred without change of name from one genus to another retains the original type even though the description under the new genus was drawn from a different species.

(*d*) The publication of a new specific name as an avowed substitute for an earlier one does not change the type of the species.

(*e*) When more than one specimen was originally cited and no type was designated the type should be selected in accordance with the following :

1. The type specimen interprets the description and fixes the application of the name, hence, primarily the description controls the selection of the type.

2. The type may be indicated by the specific name, this being sometimes derived from the collector, locality, or host.

3. If one specimen is figured in connection with the original description this may usually be regarded as the type.

4. Specimens that are mentioned by the author as being exceptional or unusual, or those which definitely disagree with the description (provided others agree) may usually be excluded from consideration in selecting the type.

5. An examination of the actual sheets of specimens studied by the author may aid in determining or selecting the type. He may have written the name or left notes or drawings upon one of the sheets.

Note.—Specimens known to have been received by the author subsequent to the study resulting in the original publication should be excluded from consideration.

6. If an author, in publishing a new species, gives a description of his own, this takes precedence over synonymy or cited descriptions, in determining the type specimen.

Article 4. The nomenclatural type species of a genus is the species or one of the species included when the genus was originally published.

(*a*) If a genus includes but one species when originally published this species is the type.

(*b*) When more than one species is included in the original publication of the genus, the type is determined by the following rules: (These rules are Articles 3 to 6 of the Report of the Committee on Generic Types published in Science, N. S., 49: 334–336, 1919.)

Recommendations: In the future it is recommended that authors of generic names definitely designate type species; and that in the selection of types of genera previously published, but of which the type would not be indicated by the preceding rules, the following points be taken into consideration. (This includes Article 7, *a* to *g*, of the Report on Generic Types published in Science, *loc. cit.*).

Section 3. Rejection of Names

Article 5. A name is rejected

(*a*) When preoccupied (homonym).

1. A specific name is a homonym when it has been published for another species under the same generic name.

2. A generic name is a homonym when previously published for another genus.

3. Similar names are to be treated as homonyms only when they are mere variations in the spelling of the same word; or in the case of specific names, when they differ only in adjective or genitive termination.

(*b*) When there is an older valid name based on another member of the same group (metonym).

(*c*) When there is an older valid name based on the same type (typonym).

(*d*) When it has not been effectively pub-

lished according to the provisions of Section 1 of these rules (hyponym).

Article 6. There may be exceptions to the application of the principles and rules of this code in cases where a rigid application would lead to great confusion. Such exceptions become valid when approved by the Nomenclature Commission.

Nomenclature Commission

A code of nomenclature should secure uniformity, definiteness and stability in the application of names. If proposed rules result in the change of well-established names of economic plants botanists will hesitate to apply them uniformly. All contingencies can not be foreseen and experience has shown that the rigid application of any set of rules results in a few cases of greatly confused nomenclature. The committee has recognized this and hence has introduced an article permitting exceptions. The committee also recognized that to secure uniformity and definiteness the exceptions should in some way be validated. The most convenient and practical validation would be through a permanent judicial body created for the purpose. As the proposed code invites international support, the judicial body should be an international commission. The committee felt that much could be done to pave the way for future international action by appointing a national commission and therefore tentatively submitted a plan for the creation of such a body. This temporary Nomenclature Commission was to consist of nine members, one nominated by the Society of American Bacteriologists, one nominated by the American Phytopathological Society, three elected by the Botanical Society of America, and four elected by the Committee on Nomenclature of the Botanical Society. The details concerning elections and reappointments are here omitted.

The chairman will add that since a subsequent international commission would feel restricted by the decisions of a national body, it might be well to have these decisions take the form of recommendations, the commission meantime perfecting rules and formulating methods of procedure. International rules of nomenclature, including rules for the retroactive fixation of generic types and including a provision for exceptions, together with an International Commission to validate names (generic types and nomina conservanda) would go far toward giving to botany a stable and uniform nomenclature.

A. S. Hitchcock,
Chairman

Bureau of Plant Industry,
Washington, D. C.

SPECIAL ARTICLES

A FISH, WITH A LUMINOUS ORGAN, DESIGNED FOR THE GROWTH OF LUMINOUS BACTERIA

It has been known for many years that luminous bacteria are abundant in the sea and will grow readily upon dead fish or other marine organisms. It has been reported that at times luminous bacteria may infect living forms, such as sand fleas. A malady is produced, which is finally fatal but which, during its course, causes the animal to luminesce like a true luminous form.[1] Pierantoni[2] has suggested that the light of many luminous organisms is due to symbiotic bacteria living in the cells of the luminous organisms. He claims to have grown the bacteria artificially in the case of certain squid.

While I feel convinced that this is not the case in all luminous animals I have recently had an opportunity[3] of studying two forms which do appear to utilize bacterial light. These are the marine fishes, *Photoplepharon* and *Anomalops,* found in the Banda Islands of the Dutch East Indian Archipelago. They have been known to be luminous since 1897, but the organ was first studied histologically by Steche[4] and found to be made up of a series of columnar gland tubes, a number of which

1 Giard and Billet, *C. R. Soc. Biol.*, I., 593, 1889.

2 Scientia, XXIII., 43, 1918.

3 A study made under the auspices of the Department of Marine Biology, Carnegie Institution of Washington.

4 *Zeit. Wiss. Zool.*, XCII., 349, 1909.

unite to a reservoir which opens to the sea water by a pore. The pores are quite regularly arranged over the outer surface of the organ from which the light emerges.

Despite the general appearance of an organ of external secretion, no luminous material is excreted to the sea water by the living fish. This rather unusual fact has, I believe, its meaning. If the organ is tested in sea water and examined under the microscope, innumerable motile rod-shaped bacteria, sometimes forming spirilla-like chains, can be seen. Smears of the organ, which I obtained in Banda, have been very kindly stained for me by Professor Dahlgren, of Princeton University, and show the bacteria nicely.

In chemical respects an emulsion of the organ behaves just as an emulsion of luminous bacteria and differs in one or another way from extracts of other luminous animals. These various characteristics may be summarized as follows:

1. The light organ is extraordinarily well supplied with blood vessels and the emulsion fully as sensitive to lack of oxygen as are luminous bacteria. Light ceases very quickly in absence of oxygen.

2. If dried, the organ will give only a faint light when again moistened with water. This is characteristic of luminous bacteria. The luminous organs of most other forms can be dried without much loss of photogenic power.

3. Luciferin and luciferase can not be demonstrated.

4. The light is extinguished *without a preliminary flash* by fresh water and other cytolytic (bacteriolytic) agents.

5. Sodium fluoride of 1 to 0.5 per cent. concentration extinguishes readily the light of an emulsion of the gland.

6. Potassium cyanide has an inhibitive effect on light production in about the same concentration as with luminous bacteria.

To these observations must be added the very suggestive fact that the light of *Photoplepharon* and *Anomalops* continues night and day without ceasing and quite independently of stimulation. This is a characteristic of luminous bacteria and fungi alone among organisms, and very strongly suggests that the light is actually due to symbiotic luminous bacteria. The organ becomes, then, an incubator for the growth and nourishment of these forms and we may perhaps look upon the pores mentioned above as a means of exit for dead bacteria. Otherwise their existance would be inexplicable in an organ which certainly does not produce an external secretion.

Actual proof that the bacteria found in the organ are luminous can only come when these are grown artificially. My attempts in this direction have failed. Good growths of bacteria were obtained on pepton-agar but they produced no light. One might expect that a symbiotic form would require rather definite food materials to produce light and it is, perhaps, not surprising that culture experiments have failed. We have Giard and Billet's experience with the form infecting sand fleas. This could be grown artificially but only produced light when infecting the sand fleas themselves. Certainly, the ocular and chemical evidence, if not the cultural evidence, supports the view that the light of these living fish is bacterial in origin. A complete account of the fish will appear shortly in the Carnegie Institution Publications.

E. Newton Harvey
Princeton University,
March 1, 1921

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION L—HISTORY OF SCIENCE SESSIONS

The growing and widespread interest in the history of science, in this country, was very evident during the Convocation Week (December 27–January 1), when two learned national organizations held meetings in Washington, D. C., and Chicago. Each of these organizations held sessions upon the history of science.

During the same week in 1919, The American Historical Association inaugurated the movement by holding at its Cleveland meeting, a most interesting and successful conference.[1] This same asso-

[1] Science, N. S., Vol. LI., pp. 193–194, February 20, 1920.

ciation again held a conference in the History of Science at its Washington meeting.[2]

This year (1920) a similar movement was instituted by the scientists, and the president of the American Association for the Advancement of Science, through the council, appointed an organizing committee consisting of the following scholars:

Dr. William W. Welch, Johns Hopkins University,
Dr. A. P. Carman, University of Illinois,
Dr. Felix Neumann, Washington, D. C.
Dr. George Sarton, Carnegie Institution,
Dr. William A. Locy, temporary chairman, Northwestern University,
Dr. Henry G. Gale, University of Chicago,
Dr. C. Judson Herrick, University of Chicago,
Frederick E. Brasch, secretary, John Crerar Library, Chicago.

Through the efforts of this committee the policy of the History of Science section was established. The principal fact to be noted, however, in conjunction with this policy, was the adoption of a plan whereby the function of the program committee was such as to offer the utmost freedom in cooperating and coordinating with existing sections in the American Association. In view of the unique position of the History of Science section relative to the older sections, the relation is such that conflicts of interest are great. Therefore, in order to advance the work and interest of the History of Science, and, at the same time, minimize this conflict—also to meet the growing interest of a large number of scholars both in the technic and history of their respective sciences, the following policy has been approved:

The program shall be flexible, so that such papers as are technical (example—mathematics) in historical treatment be given in sections where they will be most appreciated, and the more general historical papers be given in the special section (History of Science). It is also the opinion of the committee, that papers for this section shall be given by invitation.

This plan was thought most feasible, and has subsequently proven a success, as was evident at the first conference during American Association for the Advancement of Science week.

Consequently, the first joint session was held with Section A (American Mathematical Society and the Mathematical Association of America). Papers were presented by well known scholars in the History of Mathematics. The first was by Dr. Louis C. Karpinski, of the University of Michigan, who presented a most interesting topic, namely: "Geometrical development of analytical ideas."

The purpose of this paper is to show that many of the fundamental concepts of analysis had their progenitors in ideas developed by the Orientals, the Greeks, the Arabs, and the Europeans, to the time of Newton, along geometrical lines. The algebraical problems of the first degree equation in one unknown, the quadratic and the cubic, were all early solved by geometrical means; many of the dominating "motif" problems and theories of geometry lead directly to the quadratic and the cubic. The problem of the pentagon, of the trisection of the angle, of the duplication of the cube, of the conic sections of the regular polygons of seven and nine sides, and even of the squaring of the circle, all contributed to the geometrical development of analytical ideas.

With the Arabs first came the quite complete appreciation of the algebraical and geometrical correspondences, which culminated, of course, in the work of Descartes, with whom modern mathematics begins.

The second paper was given by Dr. David Eugene Smith, of Columbia University—"The earliest mathematical work printed in the New World."[3]

It was supposedly known that the earliest mathematical work printed in America was that by Isaac Greenwood, first Hollis professor of mathematics and natural philosophy at Harvard College (1727–1738). It was printed in Boston, 1729. However, it thus appears through Dr. Smith's efforts that the first mathematical book printed in America was one printed in Mexico City, 1556. Of this work, known as the "Sumario Compendiso," there remain perhaps only four copies. The book consists of one hundred and three folios, generally numbered. The author, Juan Diez, undertook the work primarily for the purpose of assisting those who were engaged in buying of gold and silver from Mexico, for the moneyed class of Spain. The principal text consists of tables relating to the purchase price of various grades of silver, and of gold, and to monetary affairs of various kinds. The mathematical text consists of twenty-four pages of problems of arithmetic and algebra. Aside from the great historical importance and rarity this book possesses, it also has an interesting place in the early history of education in America.

In the second joint meeting the third paper was presented by Dr. Florian Cajori, of the University of California. His topic, "The evolution of algebraic notations," was illustrated by slides. Due to the extremely technical character of this topic, which involved so many symbols and signs, and the tracing of the evolutionary character of the notation by a long and painstaking detail study, it is not possible to give an adequate ab-

[2] Science, N. S., Vol. LIII., p. 122, February 4, 1921.

[3] A full account of this paper is to be found in *The American Mathematical Monthly*, 28: 10–15, January, 1921.

stract here. However, Dr. Cajori pointed out that there was danger in having both too few symbols for notations, and also too many. While mathematics is essentially a science of logic by symbols, yet there is a justification for conservative use of such notations.

The most notable fact observed at these joint meetings was the keen interest shown for historical papers, which may be an innovation to the mathematicians and a matter to be considered for future meetings. It only proves too conclusively the value and importance historical papers have within the technical group. Not alone has the cultural phase been emphasized, but there is also the psychological phase. The arduous task of listening to a long series of extremely technical papers is enlivened by a reaction given by some historian's account of a period, a biography or event in mathematical progress.

Wednesday afternoon at 2 o'clock the first single session of the History of Science section took place. After a few brief introductory remarks, concerning the purpose of the History of Science section and a report of the organizing committee, Dr. William A. Locy, temporary chairman, introduced the first speaker, Dr. James H. Breasted, of the Haskels Oriental Museum, University of Chicago, who spoke at length upon "The state of research in early Egyptian science." Dr. Breasted's research has enabled him to point out the large possibilities for greater investigation in the practical unknown Egyptian sciences. His remarks gave one to understand that the future historian of science will have to labor long and hard in the fields from astronomy to medicine and engineering. The question is, where to find the student prepared for this practically unexplored field.

Dr. Walter Libby, professor of the history of medicine, University of Pittsburgh, spoke upon "John Hunter as a forerunner of Darwin." Too little seems to be known of John Hunter (1728–1793) from the point of view of a biologist. A man self-educated late in life, he rapidly rose to a position in the medical sciences, and became an authority in research into anatomical and physiological problems.

The next paper was "Sir William Osler's last historical discovery," by Mr. J. Christian Bay, medical librarian, John Crerar Library. Osler's last literary investigation was probably one of the most interesting and fascinating pieces of historical discovery of recent date in the History of Science. The place and labors of the mystic philosopher, Nicholas of Cusa (1401–1464) is not very well understood in the history of scientific thought. Mr. Bay presented phases of Osler's discovery that were practically unknown; that Cusa possessed some understanding of static electricity, that he performed experiments, and in general was far in advance in ideas bearing upon magnetism. It would thus appear that Cusa preceded William Gilbert (1540–1603) by about 150 years. At the close Mr. Bay paid a beautiful tribute to Sir William Osler, as a man, scholar and scientist.

Owing to the interesting and long discussions provoked by the preceding speakers, the time was growing short, therefore, Dr. Locy's paper was given by title only—"The earliest printed book on natural history—1475–1500."

Dr. Frank B. Dains, of the University of Kansas, presented a paper entitled "Applied chemistry in prehistoric and classical times." The work of the early people in the use of bronze, iron and other metal, showed to some extent the possibility of metallurgy being understood. Applied chemistry of the prehistoric people and in classical times is so little known that the problems of research in the history of science offer immense results. We have very little in the form of written records, but buried treasures as they are brought up by the excavations of archeologists are probably better than the records themselves. Dr. Dains pointed out, as did Dr. Breasted, that the whole history of science before Greek civilization is yet too far in the realm of the unknown.

The last paper of this group was "Early surveying and astronomical instruments in America," given by Dr. Florian Cajori, who, with the aid of illustrated views, showed a remarkably interesting collection of instruments imported, and also constructed in this country. The most complete and well constructed coast and geodetic survey instruments made for the early survey in the United States were those of Ferdinand R. Hassler. A Swiss surveyor of excellent training gave to this country his best talent and consequently laid a foundation for future work that has not been revised or repeated. Dr. Cajori brought out many interesting facts and views in relation to Hassler that were entirely new to the history of science in America.

Thursday morning was devoted to the remaining part of the single session of the History of Science section. The papers presented at this time were of much longer duration. Dr. W. Carl Rufus, of the Detroit Observatory, University of Michigan,

prepared a splendid and also unique outline of the "Proposed periods in the history of astronomy in America." Dr. Rufus showed clearly by six successive steps, or periods, how each developed and expanded into a "two-dimensional form," or system.

Beginning with the introductory period (1490–1600) he stated how astronomy played its part in early navigation and explorations. Following the colonial period (1600–1780) was the beginning of observational astronomy, dominated by John Winthrop and David Rittenhouse. Next was the apparent stationary period (1780–1830), the beginning of mathematical astronomy, established by Nathaniel Bowditch and Benjamin Peirce. Following this came the popular period (1830–1860), the beginning of practical astronomy and the rapid rise of college observatories. New astronomy (1860–1890) was the beginning of astrophysics—the study of the chemical and physical properties of the star light. The last is the contemporary or correlation period (1890–), the beginning of quantitative astrophysics.

In each of these six successive periods of course there is the overlapping in time—there is no clear demarcation setting off one period from another. Such an outline as presented by Dr. Rufus should form the basis of the history of the physical sciences in America. This paper is to appear in print in the course of a few months.

The last paper before the History of Science section was that by Dr. H. A. Bumstead, of the National Research Council and of Yale University. Dr. Bumstead presented the paper "The history of physics," which was one of a series of lectures on the History of Science given before the Yale faculty and students.

The history of experimental physics from the time of Newton to the present was given so ably and charmingly that one might almost say a standard of scholarly presentation of a scientific topic had been reached. Fortunately this paper also is to appear in one of the early numbers of the *Scientific Monthly*, and later to appear in book form. This marked the last public address of Dr. Bumstead, for on the followng day, en route to Washington, he died. The richness of Dr. Bumstead's singularly attractive personality, and the depth of his scholarship and culture have left an indelible mark on all those who have ever come in contact with him.

During the Wednesday session the election for officers of the section was held—and the following were accordingly elected:

For Vice-president: Dr. William A. Locy, Northwestern University.

For Sectional Committee: Dr. Florian Cajori, University of California; Dr. George Sarton, Carnegie Institution; Dr. Walter Libby, University of Pittsburgh; Dr. Louis C. Karpinski, University of Michigan.

For Secretary: Frederick E. Brasch, John Crerar Library, Chicago.

This holding of two conferences by two different organizations, marks the beginning of a new phase of scientific learning and scholarship in America.

In Europe much has been accomplished in the advancement of the History of Science studies, especially so in England. Oxford and Cambridge universities and University of London have recognized the cultural value and have established facilities for research work. Also, independent sections for the History of Science have been organized by the "Versammlung Deutscher Naturforscher und Aerzte," and by the "Società Italiana per il Progresso delle Scienze." The activity of the Italian historians of science is evidenced by the new publication—"Archivio di Storia della Scienza," edited by Aldo Mieli; besides other historical publications that are appearing. And it is to be desired similar publications be encouraged and supported in this country. Therefore, it is to be hoped that through cooperation and coordination the History of Science movement, thus fostered and encouraged by the American Historical Association and the American Association for the Advancement of Science, can likewise aid in this "New Humanism."

FREDERICK E. BRASCH,
Secretary

THE OPTICAL SOCIETY OF AMERICA

THE Optical Society of America was organized in 1916. As stated in its constitution, "It is the aim and purpose of this society to increase and diffuse the knowledge of optics, to promote the mutual interests of investigators of optical problems, of designers, manufacturers and users of optical instruments and apparatus of all kinds and to encourage cooperation among them." While the society pays especial attention to "applied" optics and, on this account, covers a field not previously covered, it is not to be regarded as a technological society in contradistinction to a society devoted to "pure" science. The aim of the society is to cover the field of optics, including "pure" optics as well as "optical engineering."

It solicits the support and membership of all persons "interested in optics" whatever their particular interest may be. The actual present scope of the society's activities will be best indicated by the contents of its journal and the program of its latest meeting given below.

The present membership of the society is about two hundred and twenty and is increasing rapidly. The officers for 1921 are:

President, J. P. C. Southall, Columbia University, New York City.

Vice-president, C. E. Mendenhall, University of Wisconsin, Madison, Wis.

Secretary, Irwin G. Priest, Bureau of Standards, Washington, D. C.

Treasurer, Adolph Lomb, Bausch & Lomb Optical Co., Rochester, N. Y.

Editor, Paul D. Foote, Bureau of Standards, Washington, D. C.

MEMBERS OF THE COUNCIL IN ADDITION TO ABOVE OFFICERS

Past-president (1920), F. K. Richtmyer, Cornell University, Ithaca, N. Y.

Elected Members at Large 1921: P. G. Nutting, Westinghouse Research Laboratory, East Pittsburgh, Pa.; C. E. K. Mees, Eastman Research Laboratory, Rochester, N. Y.; L. A. Jones, Eastman Research Laboratory, Rochester, N. Y.; W. E. Forsythe, Nela Research Laboratory, Nela Park, Cleveland, Ohio.

Recent meetings were held in New York February 26–27, 1920, and Chicago, December 27–29, 1920. The program of the Chicago meeting follows:

Courses in optics and optometry in Columbia University: James P. C. Southall, Columbia University.

Thermal expansion of wires used in glass seals: C. G. Peters and C. H. Cragoe, Bureau of Standards.

Refractive index of glass through the annealing range: C. G. Peters and C. H. Cragoe, Bureau of Standards.

Notes on the theory of photographic spectrophotometers: E. D. Tillyer, American Optical Company.

A new ocular micrometer: Hermann Kellner, Bausch & Lomb Optical Co.

Presentation and Discussion of the Reports of the Committees on Nomenclature and Standards: P. G. Nutting, General Chairman.

1. Colorimetry, L. T. Troland.
2. Lenses and Optical Instruments, J. P. C. Southall.
3. Optical Glasses, George W. Morey.
4. Photographic Materials, W. F. Meggers.
5. Photometry and Illumination, E. C. Crittenden.
6. Polarimetry, F. E. Wright.
7. Projection, L. A. Jones.
8. Pyrometry, W. E. Forsythe.
9. Reflectometry, A. H. Taylor.
10. Refractometry, C. A. Skinner.
11. Spectacle Lenses, E. D. Tillyer.
12. Spectrophotometry, A. H. Pfund.
13. Spectroradiometry, W. W. Coblentz.
14. Visual Sensitometry, Prentice Reeves.
15. Wave Lengths, W. F. Meggers.

(About half of the above reports were presented before the general meeting by title only.)

A comparison of monochromatic screens for optical pyrometry: W. E. Forsythe, Nela Research Laboratory.

An improved form of Pickering polarimeter for gloss measurements (by the polarization method): L. R. Ingersoll, University of Wisconsin.

An unfamiliar anomaly of vision and its relation to certain optical instruments: W. B. Rayton, Bausch & Lomb Optical Co.

Double refraction of glass tubing as indicating the strains present: A. Q. Tool and C. G. Eichlin, Bureau of Standards.

Monocular and binocular perception of contrast and brightness: Prentice Reeves, Eastman Kodak Company.

Systems of color standards: A. Ames, Jr., Dartmouth College.

A new study of the leucoscope and its application to pyrometry. (Extension of work reported at N. Y., February, 1920): Irwin G. Priest, Bureau of Standards.

Address of the retiring president of the Optical Society of America. *Some outstanding problems of physiological optics:* F. K. Richtmyer, Cornell University.

Atmospheric corrections for the Harcourt Standard Pentane lamp: E. B. Rosa, E. C. Crittenden, A. H. Taylor, Bureau of Standards.

Some major problems in photometry: E. C. Crittenden and J. F. Skogland, Bureau of Standards.

Comparative tests as to the accuracy of various methods for precision measurements of focal lengths (by title): W. O. Lytle and A. K. Bennett, Bureau of Standards.

The diffusion of light in a searchlight beam (by title): Enoch Karrer and U. M. Smith, Bureau of Standards.

Further results on the heat of absorption of glass: A. Q. Tool and C. G. Eichlin, Bureau of Standards.

A recent new system of formulæ for tracing rays through a combination of lenses: James P. C. Southall, Columbia University.

Notes on lens computation: Hermann Kellner, Bausch & Lomb Optical Co.

A new astronomical lens: Frank E. Ross, Eastman Kodak Company.

Note on the extended theory of the sectored disk used in photometry (by title): Enoch Karrer, Bureau of Standards.

Measurements of aberrations of the eye: C. A. Proctor and A. Ames, Jr., Dartmouth College.

Characteristics of retinal image: A. Ames, Jr., and C. A. Proctor, Dartmouth College.

Some notes on condenser correction in optical projection (by title): G. W. Moffit, Eastman Kodak Company.

The use of the Ulbricht sphere in measuring reflec-

tion and transmission factors (by title): ENOCH KARRER, Bureau of Standards

A comparison of retinoscopic, subjective and finally acceptable ocular corrections: CHARLES SHEARD, American Optical Company.

A new method of joining glass: C. O. FAIRCHILD, Bureau of Standards.

The effect of variations in intensity of illumination of functions of importance to the working eye (by title): C. E. FERREE and G. RAND, Bryn Mawr College.

Optical determination of stress in transparent materials: A. L. KIMBALL, General Electric Co.

The following papers were contributed by the Optical Society to a joint meeting with the American Physical Society:

Photographic reproduction of tone: L. A. JONES, Eastman Kodak Company.

The spectral distribution of energy required to evoke the gray sensation: IRWIN G. PRIEST, Bureau of Standards.

The propagation of light in rotating systems: L. SILBERSTEIN, Eastman Kodak Company.

The next meeting will be held in Rochester in October, 1921. Because of the optical industries centered in and near Rochester and the proximity to universities in which much attention is given to optics, it is expected that this will be a particularly notable and profitable meeting. The program will be announced about the end of September. Titles may be submitted to the secretary at any time prior to that date.

An important feature of the society's work lies in its continuous Committee on Standards and Nomenclature. This committee includes a number of subcommittees dealing with specific fields, such as: colorimetry, photographic materials, photometry, polarimetry, projection, pyrometry, reflectometry, refractometry, spectacle lenses, spectrophotometry, spectroradiometry, visual refraction, visual sensitometry and wave-lengths. Through the work of these committees the society is gradually bringing into being a body of standard data and standard nomenclature which will contribute materially to the progress of science.

The first number of the *Journal of the Optical Society* was issued under date of January, 1917. The publication was designated as "bi-monthly," but during the war the dates of issue were necessarily irregular and the publication discontinuous. Librarians and others will be interested in the following statement of issues. During the calendar years 1917–1919 inclusive there were six separate issues designated as follows:

Vol. I., No. 1, January, 1917.
Vol. I., Nos. 2–3, March-May, 1917.
Vol. I., No. 4, July, 1917.
Vol. I., Nos. 5–6, September-November, 1917.
Vols. II.–III., Nos. 1–2, January,March, 1919.
Vols. II.–III., Nos. 3–6, May-November, 1919.

There were no issues in the calendar year 1918.

Beginning with January, 1920, the size and style of the journal were changed, and it is now issued regularly bi-monthly.

The by-laws state eligibility to membership as follows: "Any person who has, in the opinion of the council, contributed materially to the advancement of optics shall be eligible to regular membership in the society. Any person or corporation interested in optics is eligible to associate membership." Associate members have the same privileges and duties as regular members except that they may not vote nor hold office.

The annual dues are five dollars for both classes of individual members and fifty dollars for corporation members. Dues include subscription to the journal.

Applications for membership should be addressed to Irwin G. Priest, secretary, Optical Society of America, c/o Bureau of Standards, Washington, D. C.

Payment of dues should *not* accompany application. Bill will be sent after action is taken on the application.

Information in regard to the journal may be obtained by addressing Paul D. Foote, editor, *Journal Optical Society of America*, c/o Bureau of Standards, Washington, D. C.

Sample copies of the journal can not be furnished free, but the complete table of contents for 1920 will be mailed free on request

A cordial invitation to become members is extended to all persons who are interested in the purposes and activities of the society.

IRWIN G. PRIEST,
Secretary

SCIENCE

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SCIENCE

FRIDAY, APRIL 8, 1921

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

A NEW AGENCY FOR THE POPULARIZATION OF SCIENCE

IN a democracy like ours it is particularly important that the people as a whole should so far as possible understand the aims and achievements of modern science, not only because of the value of such knowledge to themselves but because research directly or indirectly depends upon popular appreciation of its methods. In fact the success of democratic government as well as the prosperity of the individual may be said to depend upon the ability of the people to distinguish between real science and fake, between the genuine expert and the pretender.

The education of children in schools and of a few in colleges is not sufficient for this. It must be carried into maturity through such channels as the newspapers and the motion pictures. Unfortunately the rapid advance and increasing complexity of modern science has made it difficult for the general reader to follow its course and he has often given up the attempt in despair. Consequently we find the reading public divided into two classes as may be discerned in any public reading room; a minority that habitually read the scientific journals and a majority that never touch even the most popular of them.

In the effort to bridge this gap and to aid in the dissemination of scientific information, a new institution, the Science Service, has been established at Washington. It is chartered as a non-profit-making corporation and all receipts from the sale of articles, books or films will be devoted to the development of new methods of popular education in science. The governing board of fifteen trustees consists of ten scientists and five journalists.

The charter is a wide one, authorizing Science Service to publish books and magazines, to conduct conferences and lecture

courses and to produce motion pictures. Its first conference was held last summer at San Diego, California, on the problems of the Pacific, and another is planned for next summer on urbanization and ruralization.

Science Service will not at present undertake to publish any periodical of its own, for it is believed that much better results can be obtained by devoting the same effort and expense to reaching a wider range of readers through newspapers and to directing attention to the various well-edited periodicals of popular science already in existence rather than attempting to rival them.

Science Service will aim to act as a sort of liaison officer between scientific circles and the outside world. It will endeavor to interpret the results of original research as they appear in the technical journals and proceedings of societies in a way to enlighten the layman. The specialist is likewise a layman in every science except his own and he, too, needs to have new things explained to him in non-technical language.

We may not all go so far as Tolstoy who said that you can explain Kant to a peasant if you understand Kant well enough. But it is evident that part of the indifference of the public to scientific questions is due to poor presentation. When we can find writers who know their subject and are willing to devote as much attention to putting it in effective form as though it were a poem or short story there will be less reason to complain of lack of interest. Science Service will spare no pains or expense in the endeavor (1) to get the best possible quality of popular science writing and (2) to get it to the largest possible number of readers. If in doing this it can make both ends meet, so much the better. If not, it will do it anyway.

Through the generosity of Mr. E. W. Scripps, of Miramar, California, the Science Service has been assured of such financial support from the start as to insure its independence. It will not be under the control of any clique, class or commercial interest. It will not be the organ of any one association. It will serve all the sciences. It will supply any of the news syndicates. It will not indulge in propaganda unless it be propaganda to urge the value of research and the usefulness of science.

The first board of trustees of Science Service is composed as follows:

Dr. W. E. Ritter is president of the board, Mr. R. P. Scripps, treasurer, and Dr. Vernon Kellogg, vice-president and chairman of the executive committee. This committee is composed of five members, one selected from each group of trustees from the different organi-

zations represented on the board. The present members of the committee are the president and vice-president of the board, Dr. J. McKeen Cattell and Dr. J. C. Merriam. A member from the journalistic group is yet to be selected.

The headquarters of Science Service have been provisionally established in the building of the National Research Council, at 1701 Massachusetts Avenue, Washington, D. C.

As editor the board of trustees has selected Edwin E. Slosson, Ph.D., who for twelve years was professor of chemistry in the University of Wyoming and for seventeen years literary editor of *The Independent*, New York. He has been associate in the Columbia School of Journalism since its foundation and is the author of "Creative Chemistry," "Easy Lessons in Einstein," "Great American Universities," "Major Prophets of To-day," lives of Rumford and Gibbs and other scientific and literary publications.

As manager of the new enterprise the board has selected Howard Wheeler, formerly editor of the San Francisco *Daily News*, Pacific coast manager of the Newspaper Enterprise Association, managing editor of *Harpers Weekly*, and for five years editor of *Everybody's Magazine*, war correspondent and author of "Are We Ready?"

The editor of Science Service desires to receive advance information of important researches approaching the point of publicity in order to arrange for their proper presentation in the press. He also wishes to secure correspondents in every university and center of research who have the time, disposition and ability to write for non-technical journals. He particularly wants to get in touch with young men and women in the various sciences who have literary inclinations and would be willing to submit to a rigorous course of training with a view to making the writing of popular science a part of their life work.

The manager wants to learn from newspapers and periodicals what sort of scientific news they need. If editors will notify Science Service by mail or telegraph whenever they want an article on any scientific subject, an effort will be made to find the best authority to write it.

Edwin E. Slosson

THE DISTRIBUTION OF HOOKWORMS IN THE ZOOLOGICAL REGIONS

Incidental to the pursuit of some public-health problems in the Orient I observe what seems to me to be a peculiar zoological and geographical distribution of two species of hookworms which parasitize man, *Ancylostoma duodenale* and *Necator americanus* and I feel confident that a study of the distribution of these obligate parasites of man will throw some light on problems dealing with the migrations of races of mankind in the past as well as other problems in ethnology.

Ancylostoma duodenale and *Necator americanus* parasitize man with equal facility. It is as easy for a white man, Chinese, Polynesian, East Indian, Malay or Negro to become infected with *A. duodenale* as with *N. americanus* and they may become infected with either or both species of worm, but it was rather remarkable to find that just as the races of man were primarily distributed in Urasia, Africa and Oceania so there seems to have been a primary and distinctive distribution of *A. duodenale* and *N. americanus* for I found that Japanese, East Indians and Chinese from north of say twenty-three degrees north latitude, that is men of the Holarctic region, harbored a very marked predominance of *A. duodenale*. On the other hand southern East Indians, *i.e.*, Tamils and Malabaris say from south of twenty degrees north latitude as well as Malays from Sumatra, Borneo, the Malay Peninsula and Java, that is to say, men of the Oriental region, harbored a marked predominance of or were exclusively parasitized by *N. americanus*.

In studying the hookworm content of an uncontaminated group of Fijians, a mixed Polynesian and Melanesian stock, I found *A. duodenale* to be entirely absent. *N. americanus* and a few *A. ceylanicum*, picked up from dogs, represented the worms harbored.

In South Africa among Kaffirs from south of twenty-two degrees south latitude and among some tropical natives, that is to say

men from the Ethiopian region, *Necator* was the only hookworm encountered. The search was not an exhaustive one. Leiper and others, however, have recorded only *Necator* from this region.

I have not worked in Europe or northern Africa but Looss, Boycott and others report the exclusive presence of *A. duodenale* in England, western Europe, Italy and Egypt, that is to say in the European moiety of the Holarctic region.

The introduction of the negro, East Indian and Mediterranean peoples into America has obscured the picture here and research among isolated and uncontaminated Indian tribes has yet to be undertaken. This research will no doubt yield some interesting data, helpful possibly in tracing the origin of the Amerind populations; it may be possible to trace a relationship for them with Mongoloids from Holarctic or from Oriental regions.

While there is a sharply marked out regional distribution of the worms in certain areas, in others time has brought about some overlapping of the two species.

The absence of *Necator* from Europe indicates pretty positively that European soil has not been contaminated by a Negroid race from the Ethiopian region, that is Africa south of the Sahara desert. The absence of *A. duodenale* from secluded groups of mountain people in the Oriental and in Ethiopian regions is explained in a similar way. In mid-Java and in a few coast and river towns in Fiji, East Indians have brought in large numbers of *A. duodenale* within historic times.

The movements of negroes, Oriental and Mediterranean peoples are modifying the primitive worm-species-formula of non-migratory people, hence interpretations must be made from carefully selected surveys only.

It is held by some that man and his obligate parasites living in symbiosis have come along through the ages together, that the relationship has not been recently or casually acquired. If this be true we should expect to find man parasitized always by the two obligate forms and not to find man of the Holarctic regions parasitized exclusively or almost exclusively by *A. duodenale,* while man of the Oriental and Ethiopian regions parasitized exclusively or almost exclusively by *Necator americanus.* This finding in any case suggests the possibility of the distribution of the two species of worms in distinctly different zoologic as well as geographic regions being due to there having been two primitive races of man, each one originally parasitized by a particular species of worm. Certain it is that *N. americanus* is found more exclusively among black- and brown-skinned races, while *A. duodenale* is found exclusively or greatly predominates at the present time among Caucasian and Mongoloid stocks.

It may be that a Eurasiatic race of man, possibly the *Pithecanthropus* of Trinil, Java, became split off and furnished the stock from which man of Oriental and Ethiopian regions sprung. *Proliopithecus* emerging from Holarctic Africa may have been not only the parent form of man, gibbon, chimpanzee, gorilla and the orang-outang, but he may have harbored the parent form from which have arisen the different hookworm species found in the various species of anthropoids of today. Possibly the ancestral tree of the primates can be revised after a study of the host relationships of their respective obligate nematode parasites. At any rate we can say that it seems likely from the present distribution of *A. duodenale* and *N. americanus* as determined in surveys recently made of selected groups that there were originally races of man parasitized exclusively by *A. duodenale* and inhabiting the Holarctic region, that is Europe, Asia, north of the Oriental region and northern Africa; and that there were other races of man parasitized exclusively by *N. americanus* and inhabiting the Oriental region, that is the southern peninsulas of Asia and Indonesia or the Malay Archipelago; and also the Ethiopian region, that is, Africa south of the Sahara Desert.

The subject is an enticing one to pursue but further deductions should probably not be hazarded at this time by one who is merely a peregrinating parasitologist.

Samuel T. Darling
International Health Board

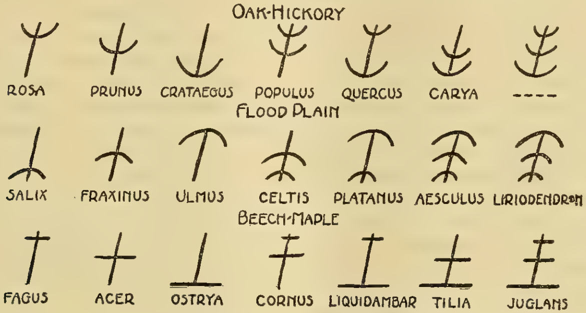
VEGETATION MAPPING

The value of accurate maps of native vegetation as a basis for very practical generalizations can not be questioned. It is obvious that an essential condition for getting accurate maps of large areas is the existence of precise maps of smaller component ones. At present very few precise local maps are available, but it is to be hoped that botanists throughout the country will begin to supplement the efforts of a few of their number who are doing map work of permanent and general value.

The workers who have contributed our various large area maps doubtless realize better than any one else the impressionistic nature of their final product. In most cases these men have done the utmost possible with scanty and vague local data. There have been, however, a few instances of buoyant disregard of the deadly principle of accumulation of error which ought not to have happened. One author, mapping a fairly large area, secured local data from a source whose authority few would care to question and then from his distant vantage point cut and trimmed until, speaking mildly, the accuracy of a considerable sector of his map was seriously impaired.

In preparing careful local maps of vegetation the question of procedure varies greatly, and is seldom an easy one. The two sources of help outlined below have been put to rather careful tests, and are presented not because of any imagined novelty but because they may prove useful to other workers under suitable conditions.

In original surveys of the forested states by government engineers the bearing trees at section corners were often listed by species, while field notes of transects present an orderly panorama of forest types passed through on each mile. The first Ohio surveys were generally done by trained woodsmen, and exhaustive field checks show that their specific determinations of trees may be pretty generally relied upon. Happily, too, there have been few serious errors in running lines—certainly nothing like the gross blunders of some of the surveyors of a later day who worked in states farther west. When one considers the genuine hardships and dangers unconsciously revealed by the field notes covering the Connecticut Western Reserve (done before 1800), for example, the excellence of the work is remarkable.



A means of utilizing these notes has been worked out after some experiment, and combines economy of time with accuracy. A set of arbitrary generic symbols was devised which could be logically grouped and readily memorized. Three typical series of symbols are shown in the accompanying table. They consist of familiar units of penmanship and can be written without much effort, while their number can be increased to cover almost

any problem without a great deal of inventiveness. Where necessary to indicate species an initial following the symbol does very well.

Using these symbols the species of bearing trees at each section corner can be transcribed onto a sheet of cross section paper with one centimeter or quarter inch squares. Where correspondence between original and modern surveys is sufficiently close it is sometimes convenient to transcribe directly upon a county road map or topographic sheet, as this gives a ready guide for field checking. With an assistant reading locations and species it was found that an average county in Ohio could be transcribed in from thirty to forty-five minutes, while one man working alone could do the job in one or two hours.

If, for publication or other reasons, a map in colors is desired, distinctive colors can be assigned to each series, and the various shades of these colors to the important species of the respective series. The symbols may then be transcribed by means of properly colored dots upon two millimeter cross section paper.

Finally and most important, it has been amply demonstrated that this network of specimen trees at one mile intervals affords a *workable* map of native vegetation, even within an area twenty miles square. One concrete instance of the usefulness of such a map within the Erie Basin of Ohio may be cited. The climax forest of glaciated Ohio is beech-maple, but there are considerable areas whose native vegetation is oak-hickory and also prairie. The map in question revealed with great promptness a correlation whose significance the reader may judge for himself; the beech-maple covers what was upland during the recession of the postglacial lake, the oak-hickory coincides with the great shallow bays formed at various stages of recession, and prairie (with occasional bog centers) marks clearly the deeper baymouths. These facts of course become especially illuminating when taken in connection with the events of to-day, patent in and about Sandusky and Maumee bays.

II

While stationed at Dorr Field, Arcadia, Florida, in 1918, the writer had excellent opportunity to test the utility of the airplane as an aid in vegetation reconnaissance and mapping. It goes without saying that experience of this sort came as a by-product of other duties which fairly filled the time.

There are two basic facts to emphasize in connection with airplane reconnaissance—first, the tremendous increase in perspective made possible, and second, the fact that each type of vegetation preserves its distinctive shade of color, and often a distinctive texture, so long as it remains visible.

Granted that vegetation types are distinctive in shade and texture from considerable altitudes, one has only to examine mosaic airplane maps made with one of the excellent automatic cameras now available to realize that this method can be just as useful for mapping vegetation as for locating gunpits or analyzing topography. Because of the cost it is not likely that extensive photographic maps will often be undertaken by individuals, but pressure from individuals may be highly instrumental in getting organized agencies to undertake methodical mapping of this kind while native vegetation still remains.

For reconnaissance mapping, however, the airplane should be of great service to the individual. The ecologist who is engaged in studying a given region ought to pause to balance the time he will spend in planning and later in piecing together isolated field studies to get their broad interpretation *against* the expense involved in taking two thirty-minute flights over the region. A minimum of two flights has been suggested because the first would permit intelligent planning of field studies while the second, taken at the conclusion of these studies, would permit their proper synthesis and criticism. Since expense is not the only objection that is likely to arise, it may not be amiss to mention that straight flying is uniformly a delightful experience and that notetaking or even map sketching can be performed with ease inside of the cockpit.

The first flight in the Dorr Field region suggested clearly the essential relations between pine flatwoods, palmetto scrub, and prairie. These relations would have developed very slowly from field studies alone, as the forms of various areas were often misleading when viewed from ground level, and significant differences of contour were matters of inches rather than feet. From the air it seemed obvious that a key to the situation lay in the rainy season water levels. The prairies were observed to form a continuous system—the pathway of broad, shallow rainy season drainage lines—the palmetto scrub formed a fringing zone that might be occasionally flooded, while the pine flatwoods marked the true uplands. The truth of these first suggestions was conclusively fixed by subsequent field work and flights in both rainy and dry seasons. Incidentally, combined ground and aerial studies forced serious doubt of the true climax nature of the pine flatwoods, which seemed in a number of places to be suffering invasion by mesophytic dicotyl forest. It was a matter of some interest to learn later that this inference was borne out by unpublished data of two other botanists working on different parts of the peninsula.

Paul B. Sears

University of Nebraska

SCIENTIFIC EVENTS

THE SYSTEMATIZATION OF PLANKTON INVESTIGATIONS

The following notice has just been received from Professor L. Joubin (Institut Océanographique, 195 Rue Saint-Jacques, Paris) the secretary of the subsection of biological oceanography of the International Union of Biological Sciences, International Research Council.

An international meeting of the delegates of the national sections was held at Paris on January 27, 1921, under the presidency of the Prince of Monaco. At this meeting it was agreed that the study of plankton is not progressing as well as might be desired, because the methods of investigation vary and therefore can not give comparable results. There is need for standardizing the fundamentals of these methods by means of the preparation of a manual which will systematize them while at the same time leaving to each investigator a free hand to perfect and to complete them. These improvements would be taken into consideration in future editions. A circular will be sent to all naturalists (zoologists, botanists, physiologists and chemists) and institutions interested and they will be requested to have it reprinted in the scientific journals and distributed among those interested in oceanography, as well as to solicit opinions, advice, criticism, and observations of any kind. A committee was named to prepare the manual and to bring the plan before the meeting of the subsection of biological oceanography in December, 1921. Specialists who desire to participate in the commission for plankton studies are requested so to inform the secretary. It is requested that all replies, printed matter, data concerning capture, instruments, fabrics, nets, reagents, preservation, and technical methods of all kinds be addressed to the secretary.

Austin H. Clark

MADAME CURIE'S VISIT TO AMERICA

(*From a Correspondent*)

Madame Marie Curie, of Paris, the student of radium, will visit this country in May as a guest of the women of America. She will bring with her her two daughters, the elder of whom is also a scientist.

Madame Curie, internationally known for her studies on radium and its application as a remedial agent for cancer, is one of three unusually gifted daughters of a Polish educator. One of her sisters is principal of an important young women's school in Warsaw and the other is director of a large sanatorium in the Galician mountains. Madame Curie went to Paris from Warsaw as a young woman to study in the Sorbonne, and while in Paris married the brilliant physicist and student of radium, Professor Pierre Curie, who met a tragic death by accident in a Paris street in 1906. She is now a teacher in the Sorbonne

and an investigator in the Curie Radium Institute, to the support of which she has devoted the money received by her from the Nobel Prize award, as also the money received from other awards.

While in America Madame Curie will be given honorary degrees by several American universities and a medal by a leading scientific society. In addition a group of women in New York and Washington are trying to raise funds sufficient to purchase and present to her, as a gift from the women of America, a gram of radium for use in her experimental work in the Curie Radium Institute. When asked recently in Paris: "What would you most prefer to have in the world?" Madame Curie promptly replied "A gram of radium under my own control."

She has never possessed such an amount of radium for her independent use, nor can she ever afford from her own means to buy it. She lives on the modest stipend received by her for her teaching and research work in the Sorbonne and does not care for more money except to put it into the equipment and support of her laboratory.

If the beautiful idea of making to Madame Curie, on the occasion of her visit here, the gift of a gram of radium in recognition of her achievements in the interests of science and humanity, can be realized, it will be the most fitting and appreciated tribute that can be paid her.

The radium will cost about $100,000 and contributions, even small sums, are earnestly solicited. If sent to Mrs. Vernon Kellogg, 1701 Massachusetts Avenue, Washington, D. C., they will be receipted and properly accounted for.

THE ROCHESTER MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE spring meeting of the American Chemical Society will be held with the Rochester Section, Tuesday, April 26, to Friday, April 29, inclusive. A large and successful meeting is assured as many thousand members of the society are within a night's journey of Rochester and reduced railroad rates have been secured. A rate of one and one half fare for the round trip journey under the certificate plan has been granted. This is good from all parts of the United States, except New England, and west of Utah, the New England and Transcontinental Association having declined to give rates. The Rochester hotel is the headquarters.

The preliminary program is as follows:

Monday, April 25

4.00 P.M.—Council meeting, Rochester Club.
6.30 P.M.—Dinner to the council at the Rochester Club.

Tuesday, April 26

10.00 A.M.—General meeting, Chamber of Commerce.
Address of welcome, Hiram Edgerton, and W. Roy McCanne, president of the Rochester Chamber of Commerce.
Response, Edgar F. Smith, president of the American Chemical Society.
General addresses, by Senator James W. Wadsworth, Jr., and Congressman Nicholas Longworth.
2.00 P.M.—General meeting, Convention Hall.
Papers, by E. C. Franklin, C. E. K. Mees and others.
6.30 P.M.—College and Fraternity dinners.

Wednesday, April 27

9.00 A.M.—Divisional meetings, Mechanics Institute.
1.30 P.M.—Divisional meetings, Mechanics Institute.
8.00 P.M.—Public address, speaker to be announced.

Thursday, April 28

9.00 A.M.—Divisional meetings, Mechanics Institute.
Sigma Xi Luncheon—Hotel Rochester.
2.00 P.M.—Divisional meetings, Mechanics Institute.
3.00 P.M.—Meeting of chairman and secretaries of local sections.
7.00 P.M.—Good-Fellowship meeting, Bausch and Lomb's Dining Hall.

Friday, April 29

8.30 A.M.—Excursions.

The following are the addresses of the divisional and sectional secretaries.

Divisions:

Agricultural and Food Chemistry: T. J. Bryan, 4100 Filmore Street, Chicago, Ill.

Biological Chemistry: H. B. Lewis, University of Illinois, Urbana, Ill.

Dye Chemistry: R. Norris Shreve, 43 Fifth Avenue, New York, N. Y.

Industrial and Engineering Chemistry: H. E. Howe, 1701 Massachusetts Avenue, N.W., Washington, D. C.

Organic Chemistry: H. T. Clarke, Kodak Park, Rochester, N. Y.

Chemistry of Medicinal Products: Edgar B. Carter, 2615 Ashland Avenue, Indianapolis, Ind.

Physical and Inorganic Chemistry: S. E. Sheppard, 83 Gorsline Street, Rochester, N. Y.

Rubber Chemistry: Arnold H. Smith, Thermoid Rubber Company, Trenton, N. J.

Water Sewage and Sanitation Chemistry: W. W. Skinner, Bureau of Chemistry, Washington, D. C.

Sections:

Sugar Chemistry: Frederick J. Bates, Bureau of Standards, Washington, D. C.

Cellulose Chemistry: G. J. Esselen, Jr., 248 Boylston Street, Boston, Mass.

Petroleum Chemistry: W. A. Gruse, Mellon Institute, Pittsburgh, Pa.

The final program will be sent about April 20 to the secretaries of sections, to the council, to members of the Rochester Section, and to all members making special request.

Charles L. Parsons,
Secretary

THE HERTER LECTURESHIP

In November, 1902, Dr. and Mrs. Christian A. Herter, of New York, gave to the Johns Hopkins University the sum of $25,000 "for the formation of a memorial lectureship designed to promote a more intimate knowledge of the researches of foreign investigators in the realm of medical science." According to the terms of the gift, some eminent worker in physiology or pathology is to be asked each year to deliver a lecture at the Johns Hopkins University upon a subject with which he has been identified.

The selection of the lecturer is made by a committee representing the departments of pathology, physiological chemistry, and clinical medicine, and if "in the judgment of the committee it should ultimately appear desirable to open the proposed lectureship to leaders in medical research in this country there should be no bar to so doing." The committee consists of Drs. MacCallum, Abel and Thayer.

The trustees of the Johns Hopkins University announce that the twelfth course of lectures on this foundation will be given by Dr. Frederick Gowland Hopkins, F.R.S., professor of bio-chemistry and director of the bio-chemical laboratory, Cambridge University. The lectures will be given in the Johns Hopkins Hospital, at 4.30 p.m. on April 12, 13 and 14, the subjects being: (1) "Oxidation and reduction mechanisms in living tissues," (2) "The function of oxygen in muscular activity," and (3) "The outlook in nutritional studies: an appraisement."

SCIENTIFIC NOTES AND NEWS

Dr. Albert Einstein, of the University of Berlin, arrived in the United States on April 2, coming in order to advance the Zionist movement, and the establishment of a University at Jerusalem. Dr. Einstein was accompanied by three other delegates, including Professor Charles Weizmann, who was head of the British Admiralty Chemical Laboratories during the war. There will be a Zionist meeting at the Metropolitan Opera House on April 10. Dr. Einstein's arrival was unexpected and no announcements have been made of scientific lectures.

The Albert medal of the Royal Society of Arts was presented on March 14 to Professor Albert Michelson, for his discovery of a natural constant which has provided a basis for a standard of length. The award was made last year, but the actual presentation was deferred until Professor Michelson could go to England to receive it.

David Charles Davies has been appointed director of the Field Museum, Chicago, to

succeed Dr. Frederick Skiff. Mr. Davies has been connected with the museum for twenty-seven years, and, as assistant to Dr. Skiff, superintended the moving of the museum exhibits from the building in Jackson Park to the new quarters in Grant Park. The museum will be opened to the public on May 3.

President Harding has reappointed Colonel E. Lester Jones to continue as head of the Bureau of Coast and Geodetic Survey, and the appointment has been confirmed by the senate.

Mr. Thomas Robertson, of the patent law firm of Robertson & Johnson, Washington, has been appointed commissioner of patents.

Surgeon John D. Long, who for the last two years has been supervisor of the U. S. Public Health Service in San Francisco, has been transferred to the office of Surgeon-General, in Washington.

A dinner of congratulation to Professor Sherrington on his election to the presidency of the Royal Society was given by the Physiological Society on March 11, at the Café Royal, London. Professor Sir E. Sharpey-Schafer proposed the toast of the guest and Professor Sherrington replied.

In recognition of the knighthood conferred upon him by the king, Sir Dawson Williams, editor of the *British Medical Journal,* was entertained by the council of the British Medcal Association at a complimentary luncheon on February 16.

Professor Douglas Johnson, of Columbia University, has been awarded the Janssen Medal by the Geographical Society of Paris, for his recent work on "Shore processes and shoreline development." This medal was founded in 1896 by the astronomer, J. Janssen, to encourage precision in the making of scientific observations, and is awarded each year "to the author or explorer who shall have made the largest number of consistent scientific observations."

Dr. Reid Hunt, professor of pharmacology in the Harvard Medical School, has been appointed by the Surgeon-General of the United States Public Health Service, a member of the advisory board of the Hygienic Laboratory to succeed the late Dr. W. T. Sedgwick.

The thirty-seventh session of the American Association of Anatomists was held at The Wistar Institute of Anatomy and Biology, Philadelphia, on March 24, 25 and 26. Dr. S. Walter Ranson, Northwestern University, and Dr. Robert J. Terry, Washington University, were elected members of the executive committee. The editorial boards of the two anatomical journals were reorganized. Dr. Charles R. Stockard, of Cornell University, was selected as managing editor of *The American Journal of Anatomy,* and Dr. John Lewis Bremer, of Harvard University, was made managing editor of *The Anatomical Record.*

A conference was held on March 25, of physicians summoned by Brigadier-General Charles E. Sawyer, President Harding's personal physician, to discuss with the president proposed plans for reorganization. Those attending the meeting were Surgeon-General Cumming, U. S. P. H. S.; Surgeon-General M. W. Ireland, of the Army; Surgeon-General E. R. Stitt, of the Navy; Dr. Charles H. Mayo, Rochester, Minn.; Dr. Edward Martin, Pennsylvania commissioner of health, and Dr. William F. Snow, New York, American Social Hygiene Association. General Sawyer said the discussion was a preliminary one to action for uniting government health units. An advisory council was formed, consisting of the Surgeon-Generals of the Army, Navy and Public Health Service and Dr. Mayo. Two other members will be added to the council, one an educator and the other a woman engaged in public welfare work.

The joint committee of the Royal Geographical Society and the Alpine Club have now completed the appointments to the reconnaissance of Mount Everest. The expedition is constituted as follows: Chief of the expedition: Colonel Howard Bury; mountaineers: Mr. Harold Raeburn (leader), Dr. A. M. Kellas, Mr. G. L. Mallory, Mr. George Finch; medical officer and naturalist: Mr. A. F. R. Wollaston. The surveyor-general of India telegraphs that, subject to the consent of the

government of India, the following officers of the Survey of India will accompany the expedition: Major H. T. Morshead and Captain Wheeler. The expedition will assemble at Darjeeling about May 10.

Miss E. M. Wakefield, F.L.S., mycologist, Royal Botanical Gardens, Kew, England, is visiting the eastern United States and Canada on her way home from the British West Indies. She was the guest of honor at a dinner given by the women mycologists and pathologists of the U. S. Department of Agriculture on March 23.

Dr. Charles A. Kofoid, of the University of California, delivered on March 29, at the Cleveland Medical Library, the third Hanna lecture on "The clinical and medical significance of parasitic infections of the human intestine with especial reference to hookworm, amebic and flagellate infections."

At a joint meeting of the Washington Academy of Sciences and the Biological Society of Washington on April 2, Dr. A. D. Hopkins, U. S. Bureau of Entomology, delivered an address on "International problems in natural and artificial distribution of plants and animals."

Professor William Duane, head of the department of bio-physics at the Harvard Medical School, gave on March 31 the first of three lectures open to the public at the Jefferson Physical Laboratory. Professor Duane spoke on "Radio Activity and X-rays."

Dr. George E. Vincent, president of the Rockefeller Foundation, recently delivered the second of the Marshall Woods lectures at Brown University, his subject being "The university and public health."

The annual meeting of the Wisconsin Academy of Sciences, Arts and Letters will be held at the University of Wisconsin on April 15 and 16. President E. A. Birge will deliver his presidential address at an informal diner for members of the academy and their friends to be held on Saturday evening, April 16.

John Burroughs, the distinguished naturalist, died on March 29, aged eighty-four years.

Dr. Delos Fall, formerly of the faculty of Albion College and for forty-one years head of the department of chemistry of that institute, died at Bradentown, Florida, on February 19.

It is announced that the 20-inch lens for the telescope at Van Vleck Observatory of Wesleyan University has been delivered. The lens was ordered in 1914 from Jena, a few days before war was declared.

Through the gift of Miss Annie M. Alexander who has pledged more than $8,000 annually for a period of years, the University of California has been enabled to organize a Museum of Palæontology. Effected primarily for the advancement of research in palæontology and historical geology, it is expected that the investigators on the fossil mammals and fossil reptiles of the Pacific coast, begun by President John Campbell Merriam, of the Carnegie Institution of Washington, formerly professor of palæontology and historical geology and dean of the faculties, will be continued in the new department. Dr. Bruce L. Clark, assistant professor of palæontology, has been named director of the museum, while E. L. Furlong, assistant in palæontology, is expected to be appointed curator of the vertebrate collections. Included in the staff will be Chester Stock, instructor in palæontology, and Mr. Charles Camp, to be named vertebrate palæontologists. Comprising thousands of specimens of fossil plants, vertebrates and invertebrates, the present collections will be turned over to the museum, and the department of palæontology will cease to have a separate existence. Proper organization of this and other collections is stated to be one of the most important purposes for which the museum has been founded.

The museum of natural history of the University of Illinois has recently acquired the collection of mollusks made by the late Anson A. Hinkley, of Du Bois, Illinois. It contains upwards of 200,000 specimens, including the types or cotypes of 113 new species and five new

genera and subgenera. It is rich in the little-known regions of Alabama and other places in the southern states, and contains extensive material from Guatemala, Venezuela, Mexico, and other parts of Central and South America. Mr. Hinkley was a careful collector and the material includes valuable data as to place and habitat. It is the most valuable scientific collection received by the university in many years. The estate of the late Dr. W. A. Nason, of Algonquin, Ill., has presented Dr. Nason's collections to the museum. These consist of about 50,000 insects, mostly American and largely Illinois, 10,000 land, fresh water, and marine mollusks, and about 2,000 plants.

Syracuse University has come into possession, by gift, of the personal herbarium of Gertrude Norton, a native of Syracuse, and a former student in Syracuse University. Miss Norton taught for some years in Salt Lake City, Utah, where she died in 1919. This herbarium embraces a collection of about one thousand specimens of the rare or more characteristic plants of Utah and of the Flathead region of Montana.

The state of Illinois has printed for the Natural History Survey of the state a second edition of a report by S. A. Forbes and R. E. Richardson on the fishes of Illinois, the original edition, published in 1908, having been out of print for several years. This report contains an account of the topography and hydrography of Illinois, a chapter on the distribution of Illinois fishes within the state and throughout the country, and full descriptions and many illustrations of the 150 species of fishes found in Illinois, with accounts of their distribution, habits, food, and uses so far as these are known. It is illustrated by 76 black and white figures and colored plates of 68 species. The main report of 492 pages is accompanied by an atlas of 102 maps of the state showing its stream systems, its glacial geology, the localities from which collections of fishes have been made by the Natural History Survey, and those from which each of the 98 more abundant species has been taken. A limited number of the edition is reserved for free distribution to libraries, educational institutions and specialists who have not received the first edition, and the remainder are offered in single copies to institutions and individuals at the cost of the reprint.

The death of Dr. John Iridelle Dillard Hinds is announced, at the age of seventy-three years. Dr. Hinds was one of the founders of the American Chemical Society. He was born in North Carolina, educated in the preparatory schools of Arkansas, was for over forty years professor of chemistry in Cumberland University, the University of Nashville and Peabody College. At the time of his death he was chemist for the Geological Survey of Tennessee.

UNIVERSITY AND EDUCATIONAL NEWS

Dr. Ernest Fox Nichols, for the past year director of physical research at the Nela Park Laboratory, Cleveland, recently professor of physics at Colgate, Dartmouth, Columbia and Yale and president of Dartmouth College, has been elected president of the Massachusetts Institute of Technology, to succeed the late Richard C. Maclaurin.

George Hoyt Whipple, director of the Hooper Foundation at the University of California, has been appointed dean of the school of medicine, dentistry and surgery of the University of Rochester.

Professor George H. Parker has been appointed director of the Harvard Zoological Laboratory to succeed Professor E. L. Mark, who will retire from active teaching at the close of the current year with the title of professor emeritus, after having spent forty-four years in the service of the university. The new director, Professor Parker, has been associated with Harvard University since his graduation in 1887, and has held a full professorship of zoology since 1906.

Dr. Olof Larsell, associate professor of zoology at Northwestern University, has ac-

cepted the position of professor of anatomy in the medical school of the University of Oregon.

DISCUSSION AND CORRESPONDENCE

OSTEOMYELITIS IN THE PERMIAN

It is always an interesting matter to be able to call attention to the earliest appearance in geological time of any phenomenon of nature which is common at the present time. It is especially important in ancient pathology to point out the similarity in form of the results of infective processes of ancient times with those of recent epochs. It is evident that the results of pathological processes have undergone no particular evolutionary change and one untrained in the study of fossil objects is able to recognize an example of osteomyelitis from the Permian if he is acquainted with modern pathology.

The present specimen which shows this interesting phase of pathology is a posterior dorsal spine of a reptile of the *Dimetrodon* type and was collected in the Red Beds of Texas by Mr. Paul C. Miller, of the University of Chicago. The spine had been fractured near its base in a simple transverse break, the line of which is still evident, and from an ensuing infection a chronic osteomyelitis developed in the shaft of the bone producing a sinus-filled tumefaction which is to-day so characteristic of that condition. This argues for the presence of infective bacteria during the Permian such as have been demonstrated by the magnificent researches of Renault in the Paleozoic of France.

This is the oldest vertebrate fossil showing the results of infection which has been seen or described, as it is likewise the oldest example of osteomyelitis. These statements apply only to fossil vertebrates for I have not sufficient knowledge of invertebrate forms to make a sweeping statement covering all fossil forms, but so far as my studies go I have seen no example of bacterial infection during the life of any Paleozoic form older than the reptile referred to above. This of course brings up the question as to the existence of a very mild form of pathology during the early geological periods. The entire problem of early pathology is, however, still an open one and hasty conclusions must not be made on insufficient data.

Roy L. Moodie
Department of Anatomy,
University of Illinois,
Chicago

THE CHROMOSOMES OF CONOCEPHALUM CONICUM

During the winter and spring of 1919-20 a study was made of the chromosomes of *Conocephalum conicum* for the purpose of determining whether or not there exists any visible difference between the chromosome groups of the two sexes. No such difference was found, but the chromosome number (haploid) is plainly nine instead of eight as reported by Farmer, Bolleter, and Escoyez. One of the chromosomes is very minute and may have been overlooked by these workers, or there may possibly be a difference in respect to the chromosome number between the European and the American races which are ascribed to this species. It is planned to secure plants from different localities and continue the study with reference to the chromosome number.

Amos M. Showalter
Department of Botany,
University of Wisconsin

THE COST OF GERMAN PUBLICATIONS

To the Editor of Science: Concerning this topic I may be allowed, as one not long ago from a neutral country, to answer Mr. Howe's and Mr. Dock's letters (Science, Nov. 26, 1920, and Dec. 24, 1920, resp.) as follows:

When, before the war, the Germans sold goods to this country at a lower price than they were sold in Germany, this fact was much resented here.

When nowadays, after the war, the Germans sell goods to this country at a higher price, nominally, than they are sold in Germany, this fact is much resented here again.

Note the inconsistency!

If German books could be imported into this country at prices prevailing in Germany

the result, most probably, would be that the American publishers would urge Congress to put high import-duties on them, as has been the case with scientific instruments. Or else, another group of people would get alarmed at the flood of German literature coming into the country and would interpret it as a revival of German propaganda.

In either case it is easy to conjecture as to who is finally to become the loser. There is no doubt but that in either case the scientist will suffer the most, the broad-gauge scientist who holds the view that science has no political limits or national boundaries.

Only a week or so ago I received a letter from my German book-dealer, a prominent publisher, by the way, who has from the start strongly opposed the placing of any surtax, whatsoever, on the export of German books and publications. He informed me that at last the German government has urged the "Börsenverein des deutschen Buchhandels" (the central organization that controls the price of books in Germany and abroad) to lower its export-tax (Valuta-zuschlag). The suggestion was acted upon favorably by this organization and as a result the tax has been lowered and fixed, for the time being, at 200 per cent. above the current price in Germany. To all appearances this percentage is not likely to go any higher since the rate of exchange, which has so far determined the surtax, has an upward trend. *Even at the present rate a German book would cost much less in this country than before the war.*

Before one may pass judgment on the cases that seem discriminatory to the disadvantage of the foreign buyer in favor of the German, one should consider the fact that nowadays and for a long time to come, the outlay for a book of say 60 marks entails a much greater sacrifice for the German scientist than three times or even five times that amount in German marks to the scientist in America.

It is the principle of "Relativity" that should guide us more in our judgments if they are to be unbiased.

The German publisher to whom I have referred, Dr. W. Engelmann of Leipzig, has likewise informed me that he, at least, has abolished all foreign surtaxes on journals published by his firm. (It is a matter of regret to him that he is not (yet?) at liberty, owing to the binding regulations of the "Börsenverein" to do the same with his own books.) Nevertheless he finds it hard to get as few as 150 subscriptions to some of his publications, a modest figure indeed, the attainment of which is necessary to continue the publication of such invaluable periodicals as the *Zeitschrift für wissenschaftliche Zoologie;* Groth's *Zeitschrift für Kristallographie und Mineralogie,* (now under the editorship of the eminent Swiss mineralogist, Professor P. Niggli, of Zürich); the *Botanische Jahrbücher;* and others. Two or three dollars in German money now enables an American scientist to take out a personal subscription for a whole year. I trust an appeal to internationally minded scientists and others is not out of place here. Subscriptions for foreign periodicals are needed and are most timely at the present writing in that they will help over times of difficulties such highly important journals of international scope as have been mentioned. Such an aid now is sure to benefit all parties concerned, both immediately and in the future.

In conclusion I may add that another scientific journal of high worth must receive financial support, either through subscriptions or voluntary gifts, if it is to be saved from permanent suspension. I am this time referring to a publication devoted to soils, namely the *International Review of Pedology* or, as it is designated abroad in French and in German respectively: *Revue internationale de pédologie* and *Internationale Mitteilungen für Bodenkunde.* A group of Dutch agricultural chemists have taken steps to insure the continuation of that publication and voluntary gifts and subscriptions are solicited. Correspondence should be addressed to Dr. D. J. Hissink, in care of the Agricultural Experiment Station, Groningen, Holland.

M. W. Senstius

Syracuse University

THE COST OF AMERICAN PUBLICATIONS IN ROUMANIA

To the Editor of Science: Foreseeing the high soar of science in the United States and desiring to be acquainted with the scientific events in that country and to pursue the activity of my numerous American friends and acquaintances, I have been for twenty years a subscriber to Science.

In December last, I renewed my subscription of seven dollars, which cost now in Roumanian money 595 lei instead of 35 lei in 1914.

In the university library of Cluj, otherwise well furnished, and in the libraries of the various institutes, the American publications are almost completely wanting; in the laboratories and clinics of our university there is no instrument or apparatus of American fabrication. The Hungarian administration, that had governed this university until 1919, had not yet discovered America.

The leaders and professors of the actual Roumanian University are very desirous to acquire the American books and periodicals; they would like to make use of the best instruments and apparatus constructed in the United States. They can not conceive that a modern and progressive university, as theirs, should lack the intellectual and technical cooperation of the American science.

But a microtome "Spencer" cost me 15,000 lei and a binocular "Spencer" 12,000 lei, to which must be added the transport and insurance expenses, etc.

There is no scientific institute that could afford such an expenditure, and no Roumanian institution can make "scientific purchases" in the United States as long as the dollar is worth 90 lei.

I take leave to draw the attention of the readers of your journal to this sad result of the world's war and to ask them if there might not be found any means to cure this evil, which is detrimental to both our nations.

I have great hopes that from the American practical spirit and high love of science will spring the best solution of this great difficulty and therefore I beg the editor of Science to open its columns to the study of that question.

I am at the disposal of the readers of Science who would desire any explanation about our university and who would like to transmit us directly their ideas or propositions.

E. G. Racovitza,
University professor, director of the Institute of Speology

University of Cluj,
Roumania

REQUESTS FOR BIOLOGICAL PUBLICATIONS

Professor Carl J. Cori has resumed his academic relations with the German university at Prague, Czecho-Slovak republic, in consequence of the transfer of the Marine Biological Station at Trieste, of which he was formerly director, from Austrian to Italian control. He desires to receive reprints and other biological works, especially those published since the outbreak of the war, which American biologists may wish to send him, at the Zoological Institute of the German university at Prague.

Charles A. Kofoid

SCIENTIFIC BOOKS

Root Development in the Grassland Formation, a Correlation of the Root Systems of Native Vegetation and Crop Plants. By John E. Weaver. Carnegie Inst. Washington Publ. 292. 18 × 26 cm., 151 pp., 25 pl., 39 text fig. Washington, 1920.

Students of plant physiology, ecology, agriculture and forestry, when they have taken occasion to survey the general field in which their own particular interests lay, must often have been greatly impressed with the extreme paucity of our knowledge of plant roots. Plant species have been described and redescribed, typical individuals have been photographed and painted, and thousands of pages in our libraries are devoted to the results of these descriptive studies and to their theoretical interpretation—but the far greater part of our accumulated knowledge of higher plants is closely confined to those portions of the plants that are readily seen and may be

easily examined. Until very recently no attempts have been made to extend observation and description to the subterranean parts of land plants, but excellent beginnings in this recondite province of botany are now available and enough has been accomplished to demonstrate that a well-rounded knowledge of plants or of any plant individual must include just as thorough study of root systems as has been devoted to the aerial parts.

Publication No. 292 of the Carnegie Institution of Washington is perhaps the most valuable contribution yet available in this new field. In this book Weaver presents the results of an enormous amount of detailed study devoted to the form and distribution of the roots of plants growing in the grasslands of the United States, this study being a continuation of the author's earlier volume on "The Ecological Relations of Roots." "Practically all of the grassland dominants have now been studied, many of them in two or more associations and under widely different conditions of environment." Descriptions of 38 new root systems of native plants are here presented and "more than 80 examinations of the root systems of crop plants have been made in widely varying soil types and conditions of growth." The root systems have been excavated with painstaking care and their form and distribution are set forth by descriptions and by diagrams drawn to scale, being frequently also illustrated by reproductions of photographs.

The point of view is primarily that of what may be called the Nebraska school of ecology. with much emphasis on the concept of plant succession and on the practical value of a knowledge of native vegetation as an indicator of agricultural possibilities.

> The phenomena of plant succession, whether ecesis, competition, or reaction, are controlled so largely by edaphic conditions and particularly by water-content [of the soil] that they can be properly interpreted and their true significance understood only from a thorough knowledge of root relations.

But the discussions involve much of the physiological, and the author's aim appears generally to be a consideration of the individual plant as a machine operating under the controlling conditions of the surroundings, both above and below the soil surface.

Since the work of charting root systems is very arduous and since the physiological processes of agricultural plants deserve attention before native plants are to be thoroughly studied in this way, it is especially gratifying that a goodly number of crop plants have received attention at the author's hands. Some striking points are shown by the following illustrations (from p. 139): Sweet clover (*Melilotus*) 116 days old had tops 1.8 ft. high and roots about 5 ft. deep in lowland soil, while the tops were only 1.5 ft. high and the roots were mainly about 5.8 ft. deep in upland soil. Oats (*Avena*) 75 days old had tops 3 ft. high in lowland and 2 ft. high in upland soil, the corresponding "working depths" of the roots being 2.6 and 3.1 ft., respectively.

The presentation of the results of these valuable investigations might rather easily have been rendered more generally clear and more readily comparable with the results of other similar studies, if the author had employed a meter-stick instead of his foot-rule. He does not appear to be consistently opposed to the use of the metric system, for some measurements are recorded in millimeters, etc., and he has grafted the decimal characteristic of the better system on to the unit of the worse; he dealt primarily with feet and inches but reduced his final values to terms of the foot and its decimal fractions.

The root characteristics of a given species are found to be "often as marked and distinctive as are those of the aerial vegetative parts," in spite of profound differences frequently concomitant with marked differences in habitat conditions. Different species of the same genus are sometimes markedly different in their root characteristics.

The volume should be familiar to all who are interested in the relations that obtain between plants, on the one hand, and the soil and air conditions of their surroundings, on the other.

B. E. Livingston

NOTES ON METEOROLOGY AND CLIMATOLOGY

PHYSIOLOGICAL METEOROLOGY

IN opening his presidential address[1] before the American Meteorological Society at Chicago in December, Professor Robert DeC. Ward directed attention to the fact that the Constitution of the Society states as its first object "the advancement and diffusion of knowledge of meteorology, including climatology, and the development of its application to public health . . . ." He said further that, in spite of the intimate relations existing between meteorology and health, there are few physicians who have even an elementary training in meteorology, and perhaps fewer meteorologists who are competent to deal with the physiological and medical relations. It appears, however, that more and more thought is being given the subject, both at home and abroad; and this interest is finding its expression in various researches and numerous papers, these, in turn, being applied practically in the control of air conditions in hospitals,[2] factories,[3] and, in fact, in many other places where human health and mechanical efficiency must be maintained at their best.

Numerous papers bearing upon the subject of physiological meteorology have been published from time to time in the *Monthly Weather Review*, and among the most important of these is one by Dr. Leonard Hill of Essex, England, on "Atmospheric environment and health."[4] Says Dr. Hill:

> The body is fashioned by nature for the getting of food by active exercise, and upon the taking of such exercise depends the proper vigorous function of the digestive, respiratory and vascular organs. Consequent on this, too, is the vigor of the nervous system and keen enjoyment of life. So, too, the healthy state of joints, muscles and ligaments, and freedom from rheumatic pains depend upon proper exercise of the body, neither over use nor under use, either of which may be associated with malnutrition and lowered resistance to infection. The hothouse conditions of life suitable for the failing powers of the aged, the injured in a state of shock and those in the last stages of wasting disease are mistakenly supposed to be suitable for the young and healthy. The traditional fear of cold is handed down from mother to children at her knee. For fear of their "catching cold," they are confined indoors and overclothed. They are debilitated and exposed at the same time to massive infection in crowded places. They require well-chosen food containing all those vitamines or principles of growth which are found in milk, the young green shoots of plants, grain foods with the germ and outer layers not removed by the miller. At the same time they require the stimulation of abundant open-air exercise to make them eat and metabolize their food. Household expenses will go up as more food is eaten by children excited by open-air exercise to keen appetite, but an immense national economy will result from a healthy, vigorous, efficient people.

But to obtain quantitative measures of the meteorological conditions most closely related to bodily comfort and health (these conditions being temperature, vapor-pressure, and velocity of air movement), recourse must be had to other devices than the familiar wet- and dry-bulb thermometers. The thermometer, Dr. Hill points out, is a static instrument, while the body is dynamic, since heat is produced at a certain rate and must be lost at an equal rate. To meet this need, Dr. Hill, in 1913, devised the *katathermometer*, which has given excellent results. The katathermometer[5] consists of "a large-bulbed spirit thermometer of standard size and shape, graduated between 100° F. and 95° F. The

[1] "Climate and Health, with Special Reference to the United States." Author's abstract in *Monthly Weather Review*, December, 1920, pp. 690–691. Published in *The Scientific Monthly*, April, 1921.

[2] See Huntington, Ellsworth, "The Importance of Air Control in Hospitals," *The Modern Hospital*, April and May, 1920, pp. 271–275 and 348–353; noted in *Monthly Weather Review*, May, 1920, pp. 279–280.

[3] Mount, Harry A., "Making Weather to Order," *Scientific American*, March 5, 1921, pp. 188 and 198.

[4] December, 1920, pp. 687–690.

[5] *Cf.* Jacob, Robert A., "The Katathermometer: An Instrument to Measure Bodily Comfort," *Monthly Weather Review*, September, 1920, pp. 497–498, for history, description and photographs of the katathermometer.

bulb is heated in hot water in a thermos flask until the meniscus rises into the small top of the bulb. It is then dried, suspended and the time of cooling from 100° to 95° F. taken with a stop watch in seconds. The number of seconds, divided into a factor number (approximately 500, and determined for each instrument) gives the cooling power by convection and radiation on the surface of the "kata" at approximately skin temperature in millicalories per square centimeter per second. The operation is repeated with a cotton muslin finger stall on the bulb and the wet "kata" cooling power obtained, a cooling power due to evaporation, radiation and convection. The difference between the two readings gives the cooling power of the evaporation alone.

It is shown by a table to what low values the cooling power can fall in stagnant air at even moderate temperatures—values that are much too low for any except the most sedentary occupations. And yet it is true that in many factories and mills where great heat is generated by rapidly moving machinery, or where workmen are subjected to high temperatures in engine rooms and about furnaces, no provision is made for the introduction of cool air, nor even for keeping the warm air in circulation. The result is that the proper vigorous activity of the respiratory and vascular organs is not maintained and illness, or general depression, with its consequent inefficiency results. An excellent example of the effect of providing proper means for cooling is that of a large steel tube factory in England, where air ducts supply air so cool that the men working before the huge furnaces actually feel cool when the furnace doors are shut. The effect is quite like the heating and cooling on a summer's day with passing clouds. It is said that the output of that factory is greater than that of any other of its kind, and there is no industrial unrest. Thus it is, that by reproducing as far as possible within doors the slight variations of temperature and air movement which outdoor workers experience, it is possible to make some progress in keeping the sedentary worker in the same robust and vigorous physical condition in which the outdoor worker finds himself. The economic importance of giving attention to these considerations is obvious.

A study of the relations between weather conditions and the incidence of certain diseases in north Atlantic states has been made by Mr. John R. Weeks, U. S. Weather Bureau meteorologist at Binghamton, N. Y.[6] From his studies he has drawn the following conclusions:

First, that a moderate degree of humidity, about 70 per cent., and a moderate temperature, about 68° F., should be maintained in dwellings;

Second, that crowding and mingling with persons having cough should be avoided;

Third, that sunshine and plenty of interior light should be sought; and

Fourth, that schools for janitors should be provided in order that the heating and ventilation of public places may be properly cared for.

The objection that a relative humidity as high as 70 per cent. indoors in winter would be difficult to maintain with a temperature as high as 68° F. is, no doubt, a valid one; but such a temperature would probably be too high for comfort with that humidity. Since it would be much easier to maintain a high humidity with a lower temperature it probably would be possible to find a practicable combination of temperature and humidity which would be entirely comfortable. In an article by William E. Watt, principal of the Graham Public School, Chicago, on "How I run my school,"[7] it is found that a temperature of 60° F. is sufficiently high for comfort if sufficient humidity is maintained. By introducing live steam into his warm air ducts he found it possible to maintain such conditions, with beneficial results to teachers and pupils.

In addition to the necessity for local con-

[6] Abstract and discussion in *Bulletin of the American Meteorological Society*, February, 1921, pp. 27–28.

[7] *The Ladies' Home Journal*, September 1, 1910, p. 20.

siderations of atmospheric conditions and health, there are the broader and more general aspects of climate and the treatment of certain diseases. Professor Ward, in the address earlier referred to, emphasized the correct understanding of the characteristics of climate and the judicious selection of climates to suit the particular ailments, for there is no "perfect" climate that will be equally beneficial for all ills.

Efforts have been made frequently to give graphical representations of climatic characteristics, especially with regard to temperature and humidity, and some of these have been very successful. Perhaps the *climograph* of Dr. Griffith Taylor, of Australia, is the most noteworthy example. Mr. B. M. Varney[8] says:

> One scarcely need point out the great usefulness, to the geographer, the business man, the physician, the teacher, any device which helps to create living conceptions of the nature of climate and weather, so leading to a better estimate of the effect of a given atmospheric environment on human affairs.

That is what the climograph seeks to do. It is a chart in which wet-bulb temperatures are plotted against relative humidity, or air temperature (dry-bulb) against relative humidity. Mr. Varney has chosen to mark certain regions of his climographs "raw," "keen," "scorching," "muggy," etc., to indicate bodily sensation. The line joining the points in the diagram wanders about among these regions and thus indicates the characteristics of the weather or climate under consideration.

Dr. Carrol E. Edson, president of the American Climatological and Clinical Association, at the meeting of the Meteorological Society mentioned above, gave the following questions as being worthy of study by the meteorologist, and referred to them as gaps in present medical knowledge:

1. Is basic metabolism different in people living at high altitudes from that of people living at low altitudes? A study of this might be called "Climatic physiology."

2. What is the effect of sudden changes—changes of altitude, temperature, moisture, wind, etc.? Experimental solution of this question is possible. This is "Physiologic meteorology."

3. Lastly, there is the study of the adaptability of the diseased mechanism to meet sudden changes: "Medical climatology."

These are a few of the aspects of the relations between meteorology and health, and indicate what an extensive field there is for investigation, both for the meteorologist and the physician.

C. LeRoy Meisinger

Washington, D. C.

8 "Some Further Uses of the Climograph," *Monthly Weather Review*, September, 1920, pp. 495–497.

SPECIAL ARTICLES

A NEW TYPE OF INHERITANCE

In a recent contribution from the Carlsberg Laboratory,[1] J. Schmidt has described a new type of inheritance found in "the millions fish," *Lebistes reticulatus*, from Trinidad. A conspicuous black spot occurs on the dorsal fin of the male in one race of this species, but it is wanting in all females of the species and also in males of a second race with which crosses were made. This spot was transmitted to all male offspring of the spotted fish, regardless of the mother's ancestry, but it was not found in the female offspring, nor did it reappear in the male offspring of such females, when they were mated with males which lacked the spot.

Further, sons of the spotted male, transmitted the spot to *all* their male offspring, not to half of them, as would be the case with an ordinary dominant Mendelian character. The inheritance of the character appears to be exclusively from father to son, females neither possessing nor transmitting it. Evidently the sperm is the sole vehicle of its transmission. It does not get into the egg at all. Moreover it is apparently transmitted by only *half* the sperm cells, those namely which are male determining in function. It therefore has, as Schmidt points out, exactly the distribution of a Y chromosome, and he suggests that a Y

1 *C. R. Travaux Laboratoire Carlsberg*, Vol. 14, No. 8, Copenhagen, 1920.

chromosome may be the vehicle of transmission, a matter which his colleague, Winge, has under investigation.

In all previously known cases of sex-linked inheritance, the egg as well as the sperm may serve as a vehicle of transmission. In *Drosophila* and man it is supposed that the X chromosome bears sex-linked characters, the female being in formula XX, so that every egg after maturation contains an X, a bearer of sex-linked characters; but in the same species the male is XY in formula, a Y replacing one of the X's found in the female. This X consequently will occur in only half of the sperm produced by the XY male, namely those which pass into female offspring, but the other sperms will contain Y instead of X and they will pass into male offspring. However, up to the appearance of Schmidt's paper, no characters had been observed to follow the path of a Y chromosome in transmission, so that Morgan characterizes the Y chromosome of *Drosophila* as "empty."

Before the mechanism of transmission of sex-linked characters had been worked out, I suggested in 1909[2] that the Y chromosome afforded a suitable vehicle for transmitting the secondary sex characters of males. But until Schmidt's publication was made this suggestion had found no support in known facts, and the demonstration by Morgan and others that characters which make their first appearance or are most often found in males, may nevertheless have their genetic basis in an X chromosome, seemed to discredit the Y chromosome as a possible organ of inheritance. The discovery of Schmidt leads me to call attention to my earlier suggestion, not for the mere satisfaction of saying "I told you so," but to renew the further suggestion which I then made and which still lacks verification, that the Y chromosome may contain the clew to the explanation of that other and very different type of sex-linked inheritance found in *Abraxas* and subsequently found to occur also in poultry.

[2] "A Mendelian View of Sex-heredity," SCIENCE Vol. 29, pp. 395–400, March 5, 1909.

Studies of sex-determination made in the last twenty years show unmistakably that in diœcious species the chromatin composition of the nucleus of the egg determines the sex of the individual into which the egg develops. Further, in many cases, if not in all, the quantity of chromatin is clearly decisive between maleness or femaleness in the individual which develops from the egg. Thus in parthenogenesis an egg which develops without chromatin reduction (in maturation) regularly develops into a female; but an egg which first undergoes chromatin reduction (usually by exactly half the total number of chromosomes), before it begins development into an embryo, if it remains unfertilized, now develops into a male. Yet if the egg, after undergoing chromatin reduction in maturation, receives a new complement of chromatin by being fertilized, it is restored again to the female status. Femaleness thus goes with the full chromatin equipment of the species, maleness with a less complete chromatin equipment.

It has further become clear through studies of sex-linked inheritance that not all kinds of chromatin are equally influential in determining sex, but that a particular chromosome called X is of preëminent, if not exclusive importance in determining sex. In the case first clearly worked out by Wilson, that of the squash-bug, the female bears in each cell-nucleus a pair of X's, whereas the male contains but one. As the remaining ten chromosomes of this species are paired in both sexes, the total chromosome count for the female is $20 + 2X = 22$; for the male it is $20 + X = 21$. The only discoverable difference between the two sexes is in the number of the X chromosomes. The number is two in the female, one in the male. The metabolic grade of maleness is attained when, in addition to the other ten pairs of chromosomes, a single X chromosome is present in the cell, but the grade of femaleness is attained only when the further addition of a second X is made. Every kind of chromatin of the species is present in the male, but a particular kind of chromatin is present in less

amount in the male than in the female. Now if the only difference between the two sexes lies in one chromosome, it is conceivable that one X might be dropped from each sex, without disturbing the sex balance. Besides the paired chromosomes which were alike in both sexes, the female would now contain one X, the male none. It is possible that this hypothetical simpler condition actually preceded the other, that the X chromosome really was at first a structure developed in the egg and handed on by this route from mother to daughter as an exclusively female structure, very much as extra-nuclear structures or plastids (chromatophores) are handed on in certain plants, or in the egg of the green hydra, being never found in the male gamete. It may be also that this condition is realized in birds and moths, but of this more later.

Now Wilson has shown, by comparative studies of the sex-determining mechanism of insects, that the single unpaired X of the male is apt to acquire a mate which he calls Y, of unknown origin and function but certainly of different nature from X. This is frequently much smaller than its synaptic mate, X, but in other cases is almost or quite as large as X, so that the chromosome count shows the same number of pairs in both sexes. Only comparative studies, coupled with experiments in sex-linked inheritance, show that throughout the series there is an odd or single X in the male, while in the female there is a pair of X's. The Y chromosome, which makes its appearance as a mate of the odd X, is now a purely male structure, counterpart of the hypothetical original single X of the female, and Schmidt's observations show that such a structure may perfectly well be a vehicle of transmission in heredity of characters which are the exclusive possession of males. For males would now form (as in *Drosophila*) two kinds of sperm, differing only in one respect. One type containing X would be female determining, the other type containing Y would be male determining when respectively they fertilized the single type of mature egg, which contained one X. If, however, by non-disjunction in maturation an egg retained two X's and was fertilized by a Y sperm, it would of necessity develop into a female (2X) (as is the case in *Drosophila,* Bridges) which nevertheless would possess inherited characters previously possessed only by males, because of the presence of the Y. Eggs of this character might (as in *Drosophila*) produce four types of gametes, viz., XX and Y, or X and XY. Sperm also (as in *Drosophila*) might be produced of the classes X, Y, and XY. A great variety of possible combinations would result, as Bridges has shown in cases of non-disjunction in *Drosophila.* Of these various combinations, two sets might give rise to stable self-perpetuating systems of the *Abraxas* type, viz., (1) female XX-Y, in which the two X's are permanently united into a single body which acts as the synaptic mate of Y, while the male is Y-Y in formula; or (2) female X-Y with an increased potency of X sufficient to determine femaleness in single dose; male Y-Y. It is true that in *Drosophila* Bridges finds Y-Y zygotes non-viable but this is no evidence that Y-Y zygotes would be non-viable in all organisms. It is also true that he finds that the non-disjoining X's may later separate, but this would not preclude permanent union of two X's in other organisms.

On the other hand, it is conceivable that the poultry type of sex-linked inheritance may not have been derived from the *Drosophila* type at all but from a simpler primitive condition in which the female bore one X, the male no X. If in a species of this type, a Y chromosome appeared in the egg as the synaptic mate of X, it would necessarily go exclusively into those eggs which were to become males and would thus seem to be an exclusive male possession even though it had originated in a female. But the male which had received Y from his mother would now produce two types of sperm, Y and no-Y. An egg transmitting Y, if fertilized by sperm also Y would produce a Y-Y male, which might prove to have greater survival value than the male which contained no Y or only a single Y. If this happened, the race would become permanently, female X-Y, male Y-Y, which in

so far as Y is concerned is exactly the condition demanded in the poultry type of sex-linked inheritance for a carrier of sex-linked characters. This line of thought leads to the following hypothetical outline of the evolution of sex-linked inheritance.

1. Sex-linked inheritance begins with the inclusion in the nucleus of the egg of a structure, X, perhaps originally found in the cytoplasm and handed on there from egg to egg in the female line, never in the male line. This structure is itself (or is attached to) the specific determiner of femaleness; it is an element which keeps the organism at the metabolic level of femaleness, its absence allowing the organism to drop down to the metabolic level of maleness. Characters (genes) located in X would pass only from mother to daughter.

2. From the foregoing state two divergent lines of evolution may have arisen.

(*a*) In one the X chromosome becomes duplicated in the female (perhaps by splitting at the reduction division) and is in consequence found in all eggs after maturation. It thus passes into male zygotes as well as female zygotes. The female will now be XX in formula, the male XO. Whatever inherited characters have their genes located in the X chromosome will now be transmitted as in *Drosophila* and man.

(*b*) A chromosome, Y, not concerned primarily in sex-determination, may develop as the synaptic mate of X in the egg; it would at once pass into male offspring and being transmitted in sperm cells would speedily produce the male type Y-Y. But in the female, Y would be kept from becoming duplex by the presence of X, the synaptic mate of Y. If Y contained genes, these would be transmitted as are the genes of sex-linked characters in poultry and other birds and in moths.

3. If in the *Drosophila* type of inheritance, Y should come to contain genes, these would be handed on from father to son, without ever entering a female zygote (*Lebistes* type). In the poultry type of sex-linked inheritance, Y would not afford a suitable mechanism for this one-sided type of inheritance, since Y there passes into females. Hence the *Lebistes* type must be a further evolution of the *Drosophila* and human type, not of the poultry type.

W. E. Castle

Bussey Institution,
March 1, 1921

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION A AND ASSOCIATED MATHEMATICAL ORGANIZATIONS

Section A of the American Association for the Advancement of Science met in Chicago on Wednesday morning, December 29, in joint session with the American Mathematical Society (Chicago Section), the Mathematical Association of America, and a group of persons interested in the History of Science.[1] Professor D. R. Curtiss, chairman of the Section, presided. Professor O. D. Kellogg, of Harvard University, the retiring chairman, gave an address entitled "A decade of American mathematics." Professor Florian Cajori gave an illustrated address on "The evolution of algebraic notations." This meeting was attended by more than 200 persons, including 80 members of the American Mathematical Society and 150 members of the Mathematical Association of America.

At the business meeting following the program, the nominations made by the sectional committee (on December 27) were approved. These nominations, which were acted upon by the council of the association at its meeting of December 31st, were as follows:

I. For Chairman of the Section, who will preside at Toronto and give his retiring address at Boston, Oswald Veblen, Princeton University.

II. For Secretary of the Section, who will hold office until the meeting of 1924–25, William H. Roever, Washington University.

According to the new constitution four instead of five members, in addition to the chairman and secretary, constitute the Sectional Committee. Therefore it was unnecessary to elect a member to succeed Professor H. L. Rietz, whose term expired with the Chicago meeting. The four members are: Dunham Jackson (January, 1920, to December, 1924), Minneapolis, Minn.; A. D. Pitcher (January, 1920, to December, 1923), Cleveland, Ohio; Gilbert A. Bliss (January, 1920, to December, 1922), Chicago, Illinois; James M. Page (January,

[1] Science, February 18, 1921 (p. 164).

1920, to December, 1921), Charlotteville, Virginia. Professor D. R. Curtiss, Northwestern University, will give the retiring address at Toronto (1921–1922).

A joint dinner for mathematicians and astronomers was given at the Quadrangle Club of Chicago University on Wednesday evening, December 29.

The following announcements concerning members of Section A are of special interest:

(1) Professor E. H. Moore, head of the department of mathematics of the University of Chicago, was elected president of the American Association for the Advancement of Science.

(2) Professor G. A. Bliss, of the University of Chicago, was elected president of the American Mathematical Society.

(3) Professor G. A. Miller, of the University of Illinois, was elected president of the Mathematical Association of America, and member of the executive committee of the council of the American Association for the Advancement of Science.

(4) The American Mathematical Society and the Mathematical Association of America were invited by the American Association for the Advancement of Science to become affiliated societies. As soon as these organizations officially accept the offer to affiliate, they will be represented on the council of the association by their respective secretaries, Professor R. G. D. Richardson, of Brown University, and Professor W. D. Cairns, of Oberlin College.

At the sessions of the American Mathematical Society on Wednesday afternoon and on Thursday, the following papers were read:

Construction of doubly periodic functions with singular points in the period parallelogram: Professor W. Paul Webber.

Boundary value problems with regular singular points: Professor H. J. Ettlinger. (Second paper.)

Note on the permutability of functions which have the same Schmidt fundamental functions: Professor E. W. Chittenden.

On kernels which have no Fredholm fundamental functions: Professor Chittenden.

Note on convergence in mean: Professor Chittenden.

Determination of the spherical transformation in Grassmann's extensive algebra: Dr. A. R. Schweitzer.

On the relation of iterative compositional equations to Lie's theory of transformation groups: Dr. Schweitzer.

Isothermally conjugate nets: Professor E. J. Wilczynski.

Transformation of conjugate nets into conjugate nets: Professor Wilczynski.

Conditions under which one of two given closed linear point sets may be thrown into the other one by a continuous transformation of a plane into itself: Professor R. L. Moore.

A closed connected set of points which contains no simple continuous arc: Professor Moore.

On the history of symbols for n-factorial: Professor Florian Cajori.

Homogeneous polynomials with a multiplication theorem: Professor L. E. Dickson.

Applications of algebraic and hypercomplex numbers to the complete solution in integers of quadratic diophantine equations in several variables: Professor Dickson.

Arithmetic of quaternions: Professor Dickson.

Determination of all general homogeneous polynomials expressible as determinants with linear elements: Professor Dickson.

I-conjugate operators of an abelian group: Professor G. A. Miller.

The integrals and associated divergent series: Professor W. D. MacMillan.

Elementary geometry in n-dimensions: Professor R. P. Baker.

Note on an ambiguous case of approximation: Professor Dunham Jackson.

On the method of least m-th powers for a set of simultaneous equations: Professor Jackson.

Note on the convergence of weighted trigonometric series: Professor Jackson.

On polynomials and their residue systems: Professor Aubrey J. Kempner. (Second paper.)

Expansion of the double frequency function into a series of Hermite's polynomials: Professor E. R. Smith.

On amicable numbers and their generalizations: Professor T. E. Mason.

On the complete characterization of the set of points of "approximate" continuity: Professor Henry Blumberg.

Comparison of different line-geometric representations for functions of a complex variable: Dr. Gladys E. C. Gibbens.

On the trigonometric representation of an ill-defined function: Professor Dunham Jackson.

An adaptation of Bing's paradox, involving an arbitrary a priori probability: Professor Edward L. Dodd.

A convergence theorem of Osgood's with an application: Professor O. D. Kellogg.

Invariant points under transformations in function space: Professors G. D. Birkhoff and O. D. Kellogg.

Fundamental points of potential theory: Professor G. C. Evans.

Functionals of summable functions: Professor W. L. Hart.

The papers of Professors Moore, Dodd and Evans, and the paper of Dr. Gibbens were read by title.

The New York meeting of the society was reported in Science of February 25.

At the sessions of the Mathematical Association of America on Tuesday and Wednesday afternoon the following papers were read:

Geometrical development of analytical ideas: Professor L. C. Karpinski, University of Michigan.
The anharmonic ratio in projective geometry: Professor E. B. Stouffer, University of Kansas.
The association's ideal for expository papers: Professor E. J. Wilczynski. (Introductory Note.)
The first work on mathematics printed in the new world: Professor David Eugene Smith, Columbia University.
Rolle's theorem and its generalizations: Professor A. J. Kempner, University of Illinois.
Some geometrical aspects of the theory of relativity: Professor L. W. Dowling, University of Wisconsin.
Note on "the metric question from the historical standpoint": Professor L. C. Karpinski, University of Michigan.
General aspects of the problem of interpolation: Professor Dunham Jackson, University of Minnesota.
Construction of double entry tables: Professor A. A. Bennett, in charge of the U. S. Ordnance Ballistic Station, Baltimore, Md.
Certain general properties of functions: Professor Henry Blumberg, University of Illinois.

In addition to the election of Professor G. A. Miller as president of the Mathematical Association of America, the following elections were made:

For Vice-president: R. C. Archibald, Brown University; R. D. Carmichael, University of Illinois.

For Members of the Board of Trustees: A. A. Bennett, U. S. Ordnance Ballistic Station; Florian Cajori, University of California; H. L. Rietz, University of Iowa; D. E. Smith, Columbia University; C. F. Gummer, Queen's University.

Seventy-two individuals and three institutions were elected to membership and a Texas Section of the association was approved.

Wm. H. Roever,
Secretary, Section A;
Arnold Dresden,
Secretary, American Mathematical Society, Chicago Section;
W. D. Cairns,
Secretary, Mathematical Association of America

THE AMERICAN SOCIETY OF AGRONOMY

The winter meeting of the society was held at Chicago in affiliation with the American Association for the Advancement of Science, on Friday, December 31.

The program follows:

SYMPOSIUM

Our Present Knowledge of Methods of Corn Breeding

Leader: H. K. Hayes, University of Minnesota, St. Paul, Minn.

The experimental basis for the present status of corn breeding: F. D. Richey. A review of experimental efforts to increase corn yields by breeding points to the following conclusions: (1) Mass selection on the basis of production of mature, sound grain per plant, under conditions of uniform stand and fertility, may be recommended as a means of at least maintaining yields. (2) There is no evidence that ear-to-row breeding can be relied upon to obtain increased yields commensurate with the cost. (3) First generation varietal crosses, and crosses or double crosses between pure lines, offer possibilities for obtaining larger yields; but the value of each combination must be determined experimentally. (4) The evidence as a whole shows clearly the value of selection in obtaining better adaptation to a specific environment and the value of hybrid vigor in obtaining larger yields. These principles, in connection with the Mendelian interpretation of heterosis as due to linked dominant growth factors, point to selection, hybridization, and further selection, all based on pure lines and controlled pollination, as the only sound basis for real corn improvement.

The bearing of modern genetic studies on corn breeding: R. A. Emerson.

Corn breeding as a hobby: H. A. Wallace. Eight rather late corn varieties were combined as pollinating parents with each of twenty rather early mother parents. Of these 160 combinations, 50 were tried out in comparison with the Iowa Station strain of Reids at Ames and the others were tried out at Des Moines. At both places a strain of Reids known as Iowa 10 proved to be the best of the eight as a pollinating parent and a Kentucky strain of Johnson Co. White proved to be poorest. During 1916, 1917, 1918 and 1919, the Iowa Station has tried out 287 hybrids and of these only 50 have outyielded the station strain of Reids. There is probably about one chance in one hundred of finding a cross of two distinct varieties which will prove to be an improvement on the best of the varieties now in use. The most promising cross so far discovered in Iowa is a cross of the Iowa Station strain of Reids with Argentine corn.

The author believes that there must eventually be special purpose corns such as 90-day corns, silage corns, etc., as well as standard grain vari-

eties. He advocates as an aid to specialized corn breeding the formation of a Corn Record Association for the registration of promising selfed strains. By proper encouragement, he believes that retired farmers could be interested in the development of selfed strains of corn as a hobby.

Progress report on the method of selection in self-fertilized lines: D. F. JONES. Selection in self-fertilized lines makes possible a control of the heredity from both the pollen parent and seed parent. Some seventy-five lines selected in this way and started from four different varieties chosen from among the best as grown in Connecticut have shown the usual segregation of type and reduction in vigor. Many clear-cut undesirable characters have appeared and are being eliminated. For example: fifteen lines have contained various forms of chlorophyll-deficient seedlings; ten, the "defective seed" factor; three, different forms of dwarf plants; two, golden plants; three, variegated plants; and five, various forms of sterility. Along with these outstanding weaknesses other marked variations in height, size of stalk, type of tassel and ear, and color of foliage have appeared. Such differences as these form the material for effective selection for productiveness.

Overcoming "root rot" by breeding: W. D. VALLEAU. In breeding for resistance to corn root rot, the fact should be kept in mind that disease-free seed probably does not exist, under average field conditions. All plants examined in the field as well as those grown in the sand box have been found to be infected. Differences in time of death of plants of a given variety under field conditions are dependent on differences in resistance of the plants to root rot, and are not the result of planting diseased or disease-free seed. Various seed treatments, including all of those commonly recommended for small grains, have failed as a means of control. Attempts to obtain disease-free seed by harvesting before ripening and protecting ears from further infection has failed as infection occurs before the milk stage. Ears may be graded according to resistance by growing seedlings in a sand box and noting the time required for the individual seedlings to rot to the surface of the sand. By this method premature death of plants has been reduced from an average of 36.1 in the checks to 8.4 per cent. in the plants from the most resistant ears. An attempt is being made to obtain pure lines of the most resistant strains by self-pollination. Self-pollination, even for many years, does not materially reduce the number of days between the death of the first and last plant from a given ear, over open-pollinated ears, in the sand box. Preliminary experiments indicate that field selection of seed from the longest-lived plants may prove a means of obtaining seed of a high degree of resistance.

Ear type selection and yield in corn: T. A. KIESSELBACH. From the seed standpoint, ear characteristics of dent corn fall into two classes, utilitarian and non-utilitarian. The utilitarian characters comprise those which indicate soundness and hereditary adaptation to certain environmental conditions. This adaptation can not be reliably forecasted by a mere ear examination. However, associated with marked differences in the plant growth habits resultant from corresponding regional differences in the environment (and especially climatic differences), are found rather distinct adaptive ear type characteristics. The more adverse plant growth conditions are for corn, the more nearly do the adapted types approach the small stalk, low leaf area, slender ear and smooth shallow kernel of flint corn. Approach of a balance or equilibrium between adverse environment and the plant and its ear type, is frequently spoken of as "running out" of the corn, whereas such a reaction is an actual betterment for the prevailing conditions. The corn grower is coming to recognize the advantage of modifying his conception of ear type to harmonize with the environment of his locality. There is no such thing as a universal best type.

Progress report on corn disease investigations: JAMES R. HOLBERT. Cooperative investigations by the Bureau of Plant Industry and certain agricultural experiment stations during the past three years have shown that the root, stalk and ear rot diseases of corn are widely distributed in this country wherever corn is grown. These diseases have been found to be a limiting factor in corn production. They may be largely controlled by careful field selection of healthy, productive plants, physical selection of seed ears, and the proper use of the germination test, as described in Farmer's Bulletin 1176. The continued selection of seed according to these recommendations has been effective in improving a number of varieties of corn. Other means for control, such as the breeding of resistant varieties, soil sanitation, and the use of certain soil correctives, are being investigated.

The present status of continuous selection experiments with corn: L. H. SMITH. Several lines

of continuous selection in corn for certain special characteristics, including both chemical and physical properties, have been carried on for many years at the Illinois Agricultural Experiment Station. Twenty-four generations of selection to influence the composition of the grain show very marked responses, and from a single original variety four diverse strains have been established, namely, high protein, low protein, high oil, and low oil. Similarly, high- and low-ear strains as well as erect- and declining-ear strains have been produced. Another example of this response to selection has been the development of a two-eared strain from an ordinary single-eared variety. In like manner differences in yield have been induced by similar methods of selection. These results all go to show something of the possibilities of profoundly modifying various characteristics by continuous selection in a cross-fertilized plant such as corn.

First generation corn varietal crosses: Fred Griffee. A brief review is made of the development of the theory which accounts for the increased vigor of F_1 crosses. Experiments are reviewed in which F_1 corn crosses are compared with their parents for yield of grain. Of 146 crosses, 113 exceeded the parental average in yield of grain and 84 exceeded the better parent. At the Minnesota station 5 flint-dent crosses tested for a period of two to six years yielded an average of 7.7 per cent. more shelled corn per acre than either parent. Particular attention is called to the cross between Minnesota No. 13 and Squaw Flint which yielded 8.4 per cent. more shelled corn per acre than Minnesota No. 13, which is the higher yielding parent, and was a week to ten days earlier in maturity than Minnesota No. 13. Such a cross appears of considerable promise for sections where early maturity is an important factor. During the first three years of the study a strain of Minnesota No. 13 was used which had been selected for type for several years. In the latter years this strain was selected primarily for yield. The increase in yield of shelled corn per acre of the F_1 cross over the better parent has averaged less for the last two years than for the first four years of the tests in the case of crosses with Minnesota No. 13. On the basis of these results it appears that, if corn were selected primarily on the basis of yield, the value of F_1 varietal crosses would be somewhat questionable.

Rust and the weather: H. L. Walster. At Fargo, N. D., blue stem spring wheat averaged 7.1 bushels per acre in 5 seasons when rust epidemics occurred, and 26.7 bushels per acre in 5 non-rust seasons. The average minimal and maximal temperatures by 10-day periods from the date of seeding show the following differences as between the respective 5-year periods:

Average Differences in Degrees F. for Each 10-day Period after Seeding. Five-year Averages

			1st	2d	3d	4th	5th	6th	7th	8th	9th
Minimals of 5 Good Years	Minus	Minimals of 5 Rust Years	−1.76	+8.50	+6.72	+7.70	+2.84	+7.24	+8.32	+1.42	+2.94
Maximals of 5 Rust Years	Minus	Maximals of 5 Good Years	−1.54	+9.16	+4.96	+4.48	+0.28	+5.74	+5.72	+4.10	+0.72

During rust years maximal temperatures rose more rapidly and reached their highest point sooner than in non-rust years. The average rainfall during April, May, June and July averaged higher in rust years than in good years. When high rainfall occurred in good years danger of rust has been offset by low temperatures. When excessively high temperatures have occurred in good years, danger of rust has been offset by droughty conditions.

P. E. Brown,
Secretary-Treasurer

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PHOTOCHEMISTRY OF THE SENSITIVITY OF ANIMALS TO LIGHT[1]

I

AN analysis of sensory stimulation, in order to be objective, must take its data from the relations between the properties of the stimulating agent and those of the responses of the animal. If the analysis is to be quantitative as well as objective, not only should the response be a qualitatively invariable reflex but, together with the source of stimulation, it should be capable of precise and easy control.

There are a number of animals which possess such characteristic responses. Typical of these are the ascidian, *Ciona intestinalis* and the long-neck clam, *Mya arenaria.* Both of these animals, when exposed to light, respond by a vigorous retraction of the siphons. It has therefore been possible to investigate quantitatively the properties of their photic sensitivity, and as a result to propose an hypothesis which accounts for this type of irritability in terms of an underlying photochemical mechanism.

I propose now to describe briefly the evidence which has been accumulated in this connection, and to present the outstanding features of the proposed hypothetical mechanism.

II

The photosensory activities of these animals possess four striking and important properties. (1) When exposed to light, the animal

[1] Delivered at the Symposium on General Physiology held by the American Society of Naturalists on December 30, 1920, at its Chicago meetings. The paper was illustrated with a number of charts which are not reproduced here. They may be found, together with the data on which this summary is based, in a series of articles in the *Journal of General Physiology* from 1918 to the present time.

responds only after a measurable interval, which is usually longer than one and a half seconds. This interval is called the reaction time. (2) The animals will respond to light only when there has been a decided increase in its intensity. (3) Once a response has been secured to a given illumination, the continued application of the same intensity fails to produce any additional effect. (4) If, following this, the animal is placed in the dark, it very soon recovers its sensitivity to the light which had previously become ineffective.

It is apparent that these four characteristics are not confined merely to these two species of animals. They belong generally to all animals which are sensitive to increased illumination. Their analysis is therefore of more than immediate interest. Their presence and their quantitative aspects have determined the nature of the hypothesis proposed, and they in turn find their explanation in terms of the hypothesis. It will therefore be well to consider these four outstanding characteristics in greater detail.

III

The reaction time is the interval from the beginning of the exposure to the beginning of the response. In *Ciona* this may vary from 2 to 10 seconds, and in *Mya* from 1.5 to 4 seconds, depending on circumstances such as temperature, intensity of light, and duration of exposure. If these are kept constant, the reaction time is constant.

Fortunately this reaction time is made up almost entirely of the time lost in the sense organ. For example, mechanical stimulation produces the same reflex as illumination. Yet the retraction of the siphons occurs so rapidly that it is not possible to measure it with a stop watch. The adjustor and effector processes, therefore, take almost no measurable time, and the reaction time is confined to the processes which take place in the receptor. This is, to say the least, highly convenient.

The reaction time, however, is not a simple interval. The total exposure to light, which it represents, is not necessary. If the animal is exposed for, say, half the reaction time, it will still respond *in the dark* at the end of the usual reaction time. By proper methods it is possible to reduce the exposure and at the same time to measure the reaction time. It is found that for each intensity of light there is a minimum exposure which will cause a response at the end of the usual reaction time. This short exposure is the sensitization period. Exposures longer than the sensitization period make no change in the duration of the reaction time; exposures shorter than the sensitization period prolong the reaction time, as will presently be described. That portion of the reaction time during which the animal is in the dark, or during which the exposure to light is not necessary, is called the latent period. Normally, therefore, the reaction time is composed of two parts: a sensitization period and a latent period.

The whole matter is strikingly illustrated with *Mya*. Here the sensitization period is extremely short. With a strong light it is only a few hundredths of a second long, whereas the latent period comprises most of the reaction time, which in such a case is about one and a half seconds.

The sensitization period varies with the intensity. The latent period however, provided certain conditions are maintained, is constant for all intensities. At room temperatures the latent period for *Ciona* is 1.76 seconds; for *Mya* it is 1.31 seconds. Since it is our purpose to study the quantitative aspects of this photic sensitivity, it is apparent that the analysis of the reaction time into its two constituents is of first rate significance. The composition of the reaction time was first discovered with *Ciona*, and it immediately opened a hitherto inaccessible field of investigation.

IV

The second characteristic of the sensitivity of these animals is the fact that they will respond to light only when it is increased. This initial action of the light must be on a photosensitive substance contained in the

sense organ. It is necessary to determine whether this action of the light on the sensory process possesses the ordinarily well-demonstrated characteristics of photochemical reactions. Photosensitive chemical reactions have been studied extensively, and certain of their properties have been found to be commonly distributed. One of these is that a definite quantity of radiant energy is associated with a definite photochemical effect. This is the well known Bunsen-Roscoe law, which states that to produce a given effect the product of the intensity and the time of exposure of the light is a constant.

Tested by this standard, the action of light in the sensory responses of *Ciona* and *Mya* is photochemical in nature. With *Ciona*, in the production of a response, the sensitization period varies inversely with the intensity, and their product is constant and equal to 4,746 meter-candle-seconds. The same is true for *Mya*. To produce the minimum stimulating effect the intensity must vary inversely as the exposure, the product of the two being in this case only 5.62 meter-candle-seconds.

Another common property of photochemical reactions is that they possess a low temperature coefficient. Whereas ordinary chemical reactions are markedly accelerated by an increase in temperature, photochemical reactions proceed at pretty much the same rate over wide ranges of temperature. Experiments show that the temperature coefficient for the action of light on the sensory activity of *Mya* is 1.06 for a rise of 10° C. This value is so characteristic for endo-energetic photochemical reactions that, combined with the applicability of the Bunsen-Roscoe law, it can lead to but one conclusion. That is that the initial effect of the light in photic stimulation is a rather simple photochemical phenomenon. These results further indicate that in order to produce a photosensory effect a definite amount of a photosensitive substance must be broken down by the light.

V

The third point which was made with regard to the sensory responses of these animals is that the continued application of the light fails to elicit any additional effect. This has been tested with intense sunlight and with artificial light of over 10,000 meter-candles intensity. The result is always the same. After the first retraction of the siphons, the animal comes into sensory equilibrium with the light. The siphons are slowly extended, and the animal appears to act as if there were no light present.

This brings us to the fourth characteristic of photic sensitivity—the one which has served as the key to the whole situation. This is the fact that when an animal has come into sensory equilibrium with a bright light, it may be made to recover its sensitivity to light by being placed for some time in the dark. The rate at which this recovery takes place is of significance, and has been carefully investigated in the case of *Mya*.

An animal is exposed to an intense light for an hour. It is then suddenly darkened, and at regular intervals its sensitivity is determined by measuring the reaction time to a light of low intensity. What one finds is this. For about three minutes the animal is still insensitive to the particular intensity used. On the fourth minute its first response appears. The reaction time when measured at this time is nearly twice as long as usual. Measured at regular intervals, the reaction time is found to decrease continuously during the next thirty-five minutes. At first this decrease is rapid, then slow, until after thirty-five minutes or so it ceases entirely, and the reaction time is at its minimum for that intensity.

The course of dark adaptation is very orderly. It is similar in the case of *Ciona*, except that it is much slower, requiring about three hours for completion.

What is the significance of these regular changes? Physically they mean that during dark adaptation the quantity of light required for a response is much greater than normal, and that this quantity decreases at first rapidly, then more slowly. The effect of the light we have shown to be the photochemical decomposition of a sensitive sub-

stance in the receptor. Therefore the amount of decomposed photosensitive material necessary for a response during dark adaptation is at first large, and gradually becomes smaller and smaller until it reaches the normal amount for that intensity.

VI

These phenomena, and many others, can be explained in terms of a simple hypothesis. In producing sensory equilibrium, the light decomposes a photosensitive substance, and at the same time causes a loss of sensitivity. The removal of the light results in a characteristic return of sensitivity. This is probably because new photosensitive material is being formed. If we assume that the action of the light is to break up the sensitive material into its precursors, and that in the dark these precursors reunite to form the sensitive substance, all of our data may be explained in terms of the kinetics and dynamics of chemical and photochemical reactions whose general properties are well known and mathematically predictable.

Consider the kinetics of the formation of a sensitive substance from its precursors. The velocity of reaction at any moment will be proportional to the concentration of the precursors. Therefore these will disappear at first rapidly, and then more slowly according to the well-known expression

$$-\frac{dx}{dt} = k(a - x)^n,$$

where $(a - x)$ represents the concentration of precursors, and n the order of the reaction, the other symbols having their usual meaning.

It is certain that the reaction time, and therefore the amount of photochemical action necessary for a response, is not proportional to the concentration of sensitive substance in the sense organ, because during dark adaptation the former decreases while the latter increases. Moreover, it becomes apparent on second thought that the sensitive substance as such is not the effective agent; it is only after it has been decomposed by the light into something else that it can produce its effect. It is therefore more likely that the amount of decomposition represented by the reaction time (more accurately, by the sensitization period) will depend not on the concentration of sensitive substance, but on the concentration of its precursors.

Let us assume this to be true. The changes in the reaction time during dark adaptation should therefore parallel the progress made in the disappearance of precursor material during their combination to form the sensitive material. A superficial resemblance between the dark adaptation curve and the isotherm of a chemical reaction is at once apparent. The resemblance however is more than superficial. The curve which best fits all of the data on dark adaptation is actually the isotherm of a bimolecular reaction, represented by the expression

$$k = \frac{1}{at} \cdot \frac{x}{a - x},$$

which is the integral form of the equation above when $n = 2$; a represents the initial concentration of precursors, x the concentration of sensitive substance at the time t, and $a - x$ is the concentration of precursors at the same time. This means that there are *two* precursors (P and A) whose concentration is decreasing because they are combining to form the sensitive substance S. The process which goes on in the sense organ may then be written

$$S \underset{\text{"dark"}}{\overset{\text{light}}{\rightleftharpoons}} P + A$$

with a full consciousness of the quantitative significance of the expression.

VII

The dynamics of this reversible photochemical reaction account for the prominent characteristics which we have described for the photosensory process. The response to an increase in illumination, the applicability of the Bunsen-Roscoe law, and the low temperature coefficient are all inherent to the light reaction, $S \rightarrow P + A$. Sensory equilibrium corresponds to the well-known station-

ary state which results when the opposing light and "dark" reactions become balanced, and no fresh decomposition products can be formed by the light. Dark adaptation very obviously is a clear function of the unopposed "dark" reaction.

More than this, however. Certain predictions may be made on the basis of this reversible reaction. Several of these have been investigated with complete success. To mention just a simple example: the "dark" reaction, $P + A \rightarrow S$, is an ordinary chemical reaction; its temperature coefficient should therefore lie between 2 and 3. This is equivalent to saying that the temperature coefficient of dark adaptation should lie between 2 and 3 for 10° C. This is precisely what has been found to be true. The temperature coefficient of dark adaptation for *Mya* is 2.4. This concept of a reversible photochemical reaction has therefore been fruitful in accounting for the known properties of photosensory stimulation, and has served to suggest the investigation of other properties. The results of these have in turn corroborated the original explanation.

VIII

So far we have considered the events which take place during the sensitization period only. The photosensory responses of these animals, however, involve the very definite existence of a latent period. In fact, in the case of *Mya,* most of the reaction time is merely latent period and nothing more. Fortunately this part of the reaction time has also yielded to quantitative methods of analysis, and as a result we can now offer an explanation of photoreception which covers not only the sensitization period, but the latent period as well.

At the beginning of this paper, in defining the different parts of the reaction time, I pointed out a significant fact. It is that if the exposure of an animal to light is made shorter than the sensitization period at that intensity, the reaction time—and consequently the latent period—is prolonged. This indicates that there is some interrelation between the two portions of the reaction time. Experiments were therefore made in which animals were exposed for varying periods of time, all less than the sensitization period. It was found that the duration of the latent period varies inversely with the length of the exposure to light.

The latent period, being the interval during which the animal may remain in the dark following the exposure, is certainly not a time during which nothing happens. We may be sure that a process takes place during the latent period which is in some way a vital link in the chain of events between the incidence of the light and the appearance of the response. Whatever this process may be, we can consider its velocity as proportional to the reciprocal of the duration of the latent period. When this is done, we find that the velocity of the latent period process is a linear function of the duration of the initial exposure to light.

During the exposure we know that the photosensitive substance S is decomposed. We may assume that for these extremely small exposures, the photochemical effect is directly proportional to the time of action of the light. It therefore follows that the velocity of the latent period process is a linear function of the photochemical effect during the exposure. In other words, the velocity of the latent period reaction is directly proportional to the concentration of freshly formed precursor substances P and A.

Such a relationship may be explained in several ways. The one finally chosen assumes that during the latent period an inert substance, L, is changed into a chemically active material, T, which then acts upon the nerve to produce the outgoing sensory impulse. This reaction, $L \rightarrow T$, is catalyzed by the presence of the freshly formed photochemical decomposition products, P and A, formed during the exposure to the light. The linear relation between velocity of reaction and concentration of catalyst is a very common one in catalyzed reactions.

In terms of this conception the latent period assumes a position of prime importance in the photosensory mechanism. The latent

period reaction is all set and ready to go, and requires only that the light change S into P and A so that the latter can catalyze the transformation of L into T, which is the end-product of the sensory process. The whole photosensory mechanism may then be summed up in the two reactions

$$S \rightarrow P + A; \quad L \| P + A \| \rightarrow T,$$

in which the symbol $\| P + A \|$ means catalysis by one or both of the precursor substances. The first of the two reactions occurs during the sensitization period; the second during the latent period.

IX

This hypothesis of photoreception is rather concrete. The concreteness of the conceptions has however proved a useful tool in the acquisition of knowledge in this field. Time does not permit the description of experiments designed to test the hypothesis in numerous ways. I can, however, mention just a few to indicate its fruitfulness.

The latent period is assumed to be a simple, chemical reaction, perhaps as hydrolysis or an oxidation. Its behavior with the temperature should therefore follow quantitatively the rule deduced by Arrhenius for the relation between the velocity constant of a reaction and the absolute temperature. This means more than a mere determination of the temperature coefficient for 10 degrees; it means a continuous relationship between temperature and velocity, following certain theoretical considerations. Experiments showed that the reaction $L \rightarrow T$ follows this prediction accurately, and that the value of the constant, $\mu = 19{,}680$, for our reaction is in accord with those usually found for hydrolyses, saponifications, etc., in pure chemistry.

Another test concerns the interrelations between the exposure and the latent period. I have mentioned that the velocity of the latent period reaction is directly proportional to the exposure (t), provided the intensity (I) is kept constant. This may be written

$$V = k_1 t.$$

If now we keep the time of exposure constant and vary the intensity we find that

$$V = k_2 \log I$$

or that the velocity is proportional to the logarithm of the intensity. Ordinary mathematical reasoning indicates that if we combine these two equations—which means experimentally that we vary simultaneously both the time and the intensity—it should be true that

$$V = kt \log I.$$

Experiments prove that this expected relationship indeed holds good.

Still another and perhaps more significant application of the proposed hypothesis has been made. This concerns the dark adaptation of the human eye. A careful analysis of the data of dark adaptation in terms of the principles discovered in these investigations has shown that dark adaptation and protoreception in the human retina are fundamentally similar in principle to the process in *Mya* and *Ciona*. As a result there has been opened up a new field of investigation in retinal photochemistry which may some day enable us to possess a reasonable theory of vision.

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THE MECHANISM OF INJURY AND RECOVERY OF THE CELL[1]

Some of the fundamental ideas of biology are extraordinarily difficult to analyze or define in any precise fashion. This is true of such conceptions as life, vitality, injury, recovery and death. To place these conceptions upon a more definite basis it is necessary to investigate them by quantitative methods. To illustrate this we may consider some experiments which have been made upon *Laminaria*, one of the common kelps of the Atlantic coast.

[1] Address for the Symposium on General Physiology at the meeting of the American Society of Naturalists, December, 1920.

It has been found that the electrical resistance of this plant is an excellent index of what may be called its normal condition of vitality. Agents which are known to be injurious to the plant change its electrical resistance at once. If, for example, it is taken from the sea water and placed in a solution of pure sodium chloride it is quickly injured, and if the exposure be sufficiently prolonged it is killed. During the whole time of exposure to the solution of sodium chloride the electrical resistance falls steadily until the death point is reached; after which there is no further change. If we study the time curve of this process, we find that it corresponds to a monomolecular reaction (slightly inhibited at the start).

This and other facts lead to the assumption that the resistance is proportional to a substance, M, formed and decomposed by a series of consecutive reactions. On the basis of this assumption we can write an equation which allows us to predict the curve of the death process under various conditions. This involves the ability to state when the process will reach a definite stage, *i.e.*, when it will be one fourth or one half completed. This can be determined experimentally with considerable accuracy.

This curve is of practical, as well as of theoretical importance, since it allows us to compare the degree of toxicity of injurious substances with a precision not otherwise attainable. The best way of doing this is to proceed as a chemist might in such cases and express the degree of toxicity by the velocity constants of the reaction (*i.e.*, of the death process) under various conditions.

From this point of view we must regard the death process as one which is always going on, even in an actively growing normal cell. In other words the death process is a normal part of the life process. It is only when it is unduly accelerated by a toxic substance (or other injurious agent) that the normal balance is disturbed and injury or death ensues.

If we wish to put this into chemical terms we may say that the normal life process consists of a series of reactions in which a substance O is broken down into S, this in turn breaks down into A, M, B and so on. Under nomal conditions M is formed as rapidly as it is decomposed and this results in a constant condition of the electrical resistance and other properties of the cell. When, however, conditions are changed so that M is decomposed more rapidly than it is formed the electrical resistance decreases and we find that other important properties of the cell are simultaneously altered.

Hence it is evident that injury and death may result from a disturbance in the relative rates of the reactions which continually go on in the living cells.

It is evident that we can follow the process of death in the organism in the same manner that we follow the progress of a chemical reaction *in vitro*. In both cases we obtain curves which may be subjected to mathematical analysis, from which we may draw conclusions as to the nature of the process. This method has been fruitful in chemistry and it seems possible that it may be equally useful in biology.

If we suppose that resistance depends on a substance, M, it may be desirable to discuss briefly certain assumptions which have been made in regard to it. The protoplasts of *Laminaria* are imbedded in a gelatinous matrix (cell wall) which offers about the same electrical resistance as sea water or dead tissue. Since the electrical resistance of the living tissue is about ten times as great as when it is killed it is evident that the living protoplasm must be responsible for the increased resistance. The living cells consist for the most part of a large central vacuole surrounded by a delicate layer of protoplasm: the sap which fills the vacuole seems to have about the same resistance as the sea water. The high resistance of the living tissue must therefore be due to the layer of protoplasm surrounding the vacuole, a layer so extremely thin as to be comparable to what is commonly called the "plasma membrane." Since the current is due to the passage of ions through

this extremely thin layer of protoplasm[2] it would seem that the electrical resistance may be regarded as a measure of the permeability of the protoplasm to ions. It is of interest in this connection to find that the measurements of the permeability of the protoplasm by a variety of other methods (plasmolysis, exosmosis, diffusion of salts through the tissue, entrance of dyes, etc.) confirm the results obtained by electrical measurement.

In view of these facts the simplest assumption which we can make concerning M is that it is a substance at the surface of the protoplasm which determines the resistance: as M increases in amount and forms a thicker layer the resistance increases, and vice versa.

Tissue which has developed under normal circumstances is found to be rather constant in its electrical resistance. This is of considerable practical importance as it enables us to test material as it comes into the laboratory and to reject any which has been injured or is in any way abnormal.

We may therefore speak of a normal degree of resistance as indicating a normal state of the tissue. If injury occurs and the resistance falls we may consider that the loss of resistance gives a measure of the amount of injury. Thus if the tissue loses ten per cent. of its normal resistance we may say that the injury amounts to ten per cent. This enables us to place the study of injury upon a quantitative basis.

In the case of *Laminaria* we find that if the injury in a solution of sodium chloride amounts to five per cent. the tissue recovers its normal resistance when replaced in sea water. If however the injury amounts to twenty-five per cent. the recovery is incomplete: instead of rising to the normal it recovers to only ninety per cent. of the normal. The greater the injury the less complete the recovery. When injury amounts to ninety per cent. there is no recovery at all.

[2] Some of the current passes between the masses of protoplasm (*i.e.*, in the cell wall) but allowance can be made for this since the relative proportion of cell wall and protoplasm remains unaltered throughout the experiment.

This is of practical interest in view of the fact that in physiological literature it seems to be generally assumed that when recovery occurs it is always complete, or practically so, as if it obeyed an "all or none" law. It is evident that partial recovery may be easily overlooked unless accurate measurements are possible. This may serve as another illustration of the fact that quantitative methods are indispensable in the study of fundamental processes.

It is evident that injury presents two aspects. One is the temporary loss of resistance which disappears, wholly or in part, when the tissue is placed under normal conditions: this may be called temporary injury. The other is the permanent loss of a part of the resistance which is observed after more prolonged exposure: this may be called permanent injury. By exposing tissue for various lengths of time to a toxic solution and observing the amount of recovery each time we may construct a time curve of permanent injury. This curve may be subjected to the same kind of mathematical treatment as the time curve of temporary injury, already discussed. The mathematical analysis leads to the conclusion that if we adopt the scheme $O \rightarrow S \rightarrow A \rightarrow M \rightarrow B$ we must regard temporary injury as due to the loss of M while permanent injury is due to the loss of O. Recovery occurs when the loss of M is replaced by a fresh supply of M derived from O, but if O is itself depleted recovery will be incomplete.

It may be added that an equation has been found which enables us to predict the recovery curves under a great variety of conditions with considerable accuracy.

If we accept the conclusions stated above we are obliged to look upon recovery in a somewhat different fashion from that which is customary. Recovery is usually regarded as due to the reversal of the reaction which produces injury. The conception of the writer is fundamentally different; it assumes that the reactions involved are irreversible (or practically so) and that injury and recovery differ only in the relative speed at

which certain reactions take place. Thus in the series of reactions

$$O \rightarrow S \rightarrow A \rightarrow M \rightarrow B,$$

if the rate of $O \rightarrow S$ becomes slower than the normal, injury will occur, while a return to the normal rate will result in recovery. Injury could also be produced by increasing the rate of $M \rightarrow B$, or decreasing the rate of $S \rightarrow A$ or $A \rightarrow M$.

If life is dependent upon a series of reactions which normally proceed at rates bearing a definite relation to each other, it is clear that a disturbance of these rate-relations may have profound effects upon the organism, and may produce such diverse phenomena as stimulation, development, injury and death. It is evident that such a disturbance might be produced by changes of temperature (in case the temperature coefficients of the reactions differ) or by chemical agents. The same result might be brought about by physical means, especially where structural changes occur which alter the permeability of the plasma membrane or of internal structures (such as the nucleus and plastids) in such a way as to bring together substances which do not normally interact.

In the case of *Laminaria* death may occur in two ways. In the first there is a loss of resistance which continues until the death point is reached, as, for example, in sodium chloride. In the second, as in calcium chloride, there is an increase of resistance followed by a decrease. Both of these methods may be predicted by means of the scheme already outlined.

If we mix sodium chloride with calcium chloride we do not get a result which is merely intermediate for we find that long after death has occurred in pure sodium chloride or pure calcium chloride the tissue still survives in a mixture of these salts (made in certain definite proportions). The facts lead us to assume that both sodium and calcium combine with a constituent, X, of the protoplasm, forming a compound Na_4XCa. According to the laws of mass action we may calculate the amount of this compound which will be formed in each mixture of sodium and calcium chlorides. These calculations indicate that the speed of all the reactions is regulated by the amount of Na_4XCa (it is also found that certain reactions are accelerated by calcium chloride).

This enables us, by means of the equations already mentioned, to predict the time curves of injury and death in mixtures (in addition to those in pure salts) as well as the recovery curves when tissue is transferred from such mixtures to sea water.

It is evident therefore that the theory not only explains why pure sodium chloride and calcium chloride are toxic but also why they antagonize each other in mixtures. Moreover the explanation which it furnishes is a quantitative one, *i.e.*, it shows just what degree of antagonism is to be expected in each mixture.

Extremely interesting results are obtained when the tissue is first exposed to sodium chloride, then to calcium chloride, then to sodium chloride or to sea water and so on. By varying the conditions of the experiment a very complicated set of curves may be obtained. It is rather remarkable to find that all of these may be predicted with considerable accuracy by means of the equations already referred to. A detailed statement of the results will be found in recent papers in the *Journal of General Physiology*.

Throughout these investigations the aim has been to apply to the study of living matter the methods which have proved useful in physics and chemistry. The attempt presented no serious difficulties after accurate methods of measurement had been devised: nor does there seem to be any real obstacle to a general use of methods which lead biology in the direction of the exact sciences.

It is evident that if the facts have been correctly stated such fundamental conceptions as vitality, injury, recovery and death may be investigated by quantitative methods. This leads us to a quantitative theory of these phenomena and a set of equations by which they can be predicted. It may be added that the

predictive value of these equations is quite independent of the assumptions upon which they were originally based.

This investigation of fundamental life processes shows that they appear to obey the laws of chemical dynamics. It illustrates a method of attack which may throw some light upon the underlying mechanism of these processes and assist materially in the analysis and control of life-phenomena.

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ISAO IIJIMA

Professor Isao Iijima, head of the department of zoology in the Imperial Uinversity, died of apoplexy at his home in Tokyo on March 14. His father, a Samurai of the Daimyo Inouyé of Shizuoka, was one of those devoted to foreign learning in the decades before the restoration: proceeding to Nagasaki, he studied European ideas through the medium of the Dutch language—later suffering imprisonment on account of these interdicted studies. The son Isao, born Bunkyu-ni-nen (1860), followed the father's footsteps, was early a student of foreign languages and science, and was eager to master physiology and anatomy. So he found his way presently to the Imperial University of Tokyo, which then was beginning its famous career. Here he came under the guidance of the American zoologist, Professor Edward S. Morse, whose inspiration soon turned him from medical studies to pure science. Thereafter he went to Leipsic, where he took his doctorate with Professor Leuckart. Returning to Japan about 1885, he was appointed a member of the faculty of the Imperial University, where he was to remain until the day of his death; in the last years he was also professor in zoology at the Nobles' College, Tokyo. Foreign zoologists will always remember Iijima, side by side with Kakichi Mitsukuri, as taking foremost and genial place in all zoological matters in Japan. His knowledge of the general subject was unusually wide: a fluent lecturer, an attractive personality, he popularized zoology and brought help to it from many sides; for not only was he the trained morphologist, but the old school naturalist as well, bird expert notably, having among his friends collectors and gunners in all part of Japan; his hobby took him everywhere, and as a good shot he was as welcome in the hunting parties of the Emperor as with the pheasant-stalking peasants on the hillside near Misaki—where for many years he spent his summers. Here was the seaside laboratory of his zoological department, and offshore were the great depths of Okinosé (6,000 meters) from which many a red-turbaned fisherman, and Kuma Aoki especially, brought him the rarest of glass-sponges. These Iijima made his life-long study: and he dealt with them in memoirs which, published in the main in the *Journal of the Science College*, are classics, indeed—though Iijima himself would be apt to add, in his joking way, that this was not as great a feat as it seemed, since he was the only life-long specialist in the field! In point of fact, these sponges were poorly represented throughout the world (large museums had sometimes not more than a few small specimens—usually a ragged Hyalonema, or a defective Venus-basket), till the discovery was made of many species, genera, and even families of them in Iijima's district of the Pacific where nature seemed to have taken many pains to keep them alive in an early geological "garden."

In a practical direction Iijima's studies carried him to the culture of "artificial" pearls, and several of his students, the late Dr. Nishikawa especially, developed this industry with great success—having devised new modes of causing the pearl oyster to produce hemispherical, more-than-hemispherical, and in the latest time completely spherical pearls.

Bashford Dean

SCIENTIFIC EVENTS

EX-SECRETARY MEREDITH ON RESEARCH

(*From a correspondent*)

The organization of research is now receiving so much attention that the fear is ex-

pressed that more fundamental considerations are being overlooked. The words of Edwin T. Meredith, former Secretary of Agriculture, may, then, serve as a timely warning. In a statement published under the title "My Year in the Department," in the *Country Gentleman* for February 26, 1921, he points out as requisite for the successful prosecution of research in a large organization these fundamentals: Securing the right kind of men; providing them with adequate appropriations for research; freeing them from irksome restrictions in the expenditure of those funds; and providing for adequate publication of their results. That Mr. Meredith speaks with full appreciation of the importance of research, is shown by his administration and by its straightforward statement in the same article.

Research is the foundation of agricultural progress. Without it most of our agricultural activities could not exist. Our most important methods are based on the results of years of patient investigation. There is no real progress without scientific study applied to everyday problems. So much had been accomplished through research that many people may fall into the error of thinking that not much more work of this character is needed and that the requirements of the day relate merely to the application of knowledge already in hand. Research is more essential now than ever before, and the need does not relate wholly to taking care of the future. We are confronted today with serious problems of the most pressing nature, about which we know very little. . . .

Without minimizing in any degree any of the activities of the department or the other suggestions that have been made for strengthening certain features of the work, I place particular emphasis at this time on the importance of personnel, the value of research and the need of the most intensive study possible of marketing problems.

I place the problem of personnel first. It is the corner stone, you might say, of the whole structure. To secure the right kind of men the department must be able to pay higher salaries, and it must be free from some of the limitations which are now imposed on the expenditure of its appropriations. I am not decrying legal safeguards, which always must be imposed on the expenditure of public money, but I do deplore unnecessary restrictions which result in subordinating good judgment and business-like management to routine and fiscal control.

Appropriations for research are the equipment of the worker, and unless he is properly equipped he can not be expected to get results. And in this connection I regard, as a part of his equipment, funds for publishing the results of his work. Nothing is more discouraging to a scientific worker than to be denied the right to publish the facts he has learned after years of patient investigation.

So much has been written recently of the alleged inefficiency of government workers that it is inspiring to hear, from an executive officer on the eve of his retirement, a quite different statement.

The work of the department, taking it all the way through, is done by as earnest and as able a lot of men and women as any with whom I have ever come in contact. On the whole, they work as many hours a day and as efficiently, I believe, as employees in most private establishments, and they are paid less. Large numbers of them are held to their work by their love for it. Many formerly with the department were offered so much more money in private employment that, in justice to themselves and their families, they could not refuse to go.

In a single year 8,000 of these workers left the department. Those who left last year received from private concerns and other institutions an average increase in salary of more than 50 per cent.; and there are instances of increases running as high as 500 per cent. If the men and women in the department were not efficient private industry would not be offering them such increases in salary. Those remaining are as efficient as those who have gone, and many of them have declined just as tempting offers. They have said in spite of low salaries and high living costs they are going to stay where they render the greatest service to the nation.

SCIENTIFIC LEGISLATION

The *Journal* of the Washington Academy of Sciences notes the following matters of scientific interest in the third session of the Sixty-sixth Congress convened on December 6, 1920:

Under a special rule adopted on December 14, the joint resolution (S.J. 191) to create a

joint commission on reorganization of the administrative branch of the Federal Government was brought up for two hours' debate on that date and passed by the House, having already passed the Senate on May 10. The bill became Public Resolution No. 54 on December 30 without executive approval. The resolution requires the committee to make a report in December, 1922. Mr. Smoot announced in February that the committee would do the work personally and would not turn it over to the Bureau of Efficiency or any other governmental agency. Considerable shifting and rearrangement of the scientific bureaus has been predicted as a probable outcome of the reorganization movement.

The House Committee on Patents recommended on December 10 that the Nolan Patent Office bill (H.R. 11984) be sent to conference, but unanimous consent for such reference was refused in the House. Later, on December 14, the bill was sent to conference, and hearings were reopened by the conference committee in January. Section 9 of the bill, providing for the issuance of patents to Federal employees, continued to meet with opposition from commercial and industrial interests, but was retained in the bill. The House agreed to the conference report on February 16. Opposition developed in the Senate, and the bill did not reach final action before the end of the session on March 4.

The bill for Federal supervision of the nitrate plants (S. 3390), including provision for research on the fixation of nitrogen, was made the unfinished business in the Senate on December 15. After several debates and the adoption of a number of amendments, the bill passed the Senate on January 14. The House took no final action.

The American Society of Zoologists, at its annual meeting on December 28–30, 1920, passed resolutions protesting against the passage of that part of H.R. 7785 (the scientific apparatus tariff bill) which abolishes the "duty-free privilege" to educational institutions. Occasional protests against this feature of the bill have been discussed in current scientific and technical periodicals. This feature of the bill was brought up in a hearing on the Fordney emergency tariff bill before the House Committee on Ways and Means on February 14, and the sentiment of the committee seemed to be strongly in favor of eliminating the duty-free privilege on chemical glassware, chemical porcelain and apparatus. The Fordney bill passed both houses, but was vetoed by the president.

As for the special bill for a tariff on scientific supplies (H.R. 7785), although it had passed the House as long ago as August 2, 1919, the Senate took no final action and it lapsed with the adjournment on March 4.

A bill "to fix the metric system of weights and measures as the single standard for weights and measures" was introduced in the House by Mr. Britten on December 29 (H.R. 15420), and in the Senate by Mr. Frelinghuysen (by request) on December 18 (S. 4675). The bills are said to have been "fathered" by the World Trade Club of San Francisco. They were referred to the respective weights and measures committees and no further action was taken.

The Smith-Towner bill to create a Department of Education (S. 1017 and H.R. 7) after lying dormant through nearly the entire life of the Congress, was reported in the House on January 17 and in Senate on March 1, but progressed no further.

A step toward the erection of the proposed building for the National Academy of Sciences was taken in the introduction of S. 4645, "to authorize the Commissioners of the District of Columbia to close upper Water Street between 21st and 22d Streets, N.W." The bill pased the Senate on February 24, but advanced no further.

With the adjournment of the Sixty-sixth Congress at noon on March 4, various other bills and resolutions which are of interest to scientific men either perished in committees or at an intermediate stage of progress.

LECTURES BEFORE THE SIOUX CITY ACADEMY

The Academy of Science and Letters of Sioux City, Iowa, arranged for the present year a weekly lecture program as follows:

"The culture areas of the early Iowa Indian," Professor Charles R. Keyes, Cornell College.

"The origin of the prairies." Professor B. Shimek, Department of Botany, University of Iowa.

"From Iowa to New Zealand and back," Rev. L. M. Dorreen, Sioux City.

"How we Americans select our President," Professor L. E. Aylesworth, Department of Political Science, University of Nebraska.

"Problems of Jackson's administration," Professor H. W. Caldwell, Department of History, University of Nebraska.

"Transmutation of elements," Professor M. E. Graber, Department of Physics, Morningside College.

"The last stand of the Sioux," Hon. Doane Robinson, State Historian, Pierre, S. D.

"Unfinished Iowa," Professor O. E. Klingaman, director of Extension Department, University of Iowa.

"History of American art," Professor Paul H. Grummann, Dean of the Department of Fine Arts, University of Nebraska.

"The history of the Missouri," Professor Freeman Ward, Department of Geology, University of South Dakota.

"Periods of architecture in America," W. L. Steele, Architect, Sioux City.

"Becoming acquainted with the suns," Professor G. D. Swezey, Department of Astronomy, University of Nebraska.

"Survey of prehistoric man," Professor H. G. Campbell, Department of Philosophy, Morningside College.

"Our raw material," Professor Hattie Plum Williams, Department of Sociology, University of Nebraska.

"Our native landscape of Mid-America," Mr. Jens Jensen, Ravinia, Ill.

" Our local bird life," Professor C. S. Thoms, Department of Sociology, University of South Dakota.

"Remaking the face of Iowa," Professor R. B. Wylie, Department of Botany, University of Iowa.

COOPERATION OF NATIONAL HEALTH AGENCIES

Coordination of the work of voluntary national health agencies has been effected on May 1, a number of these organizations will take possession of two floors of the Penn Terminal Building, in Seventh Avenue at Thirty-first Street, New York City. The National Health Council was formed last fall by organizations, each of which will retain full autonomy. The new arrangement is in no sense a merger, but an effort to bring the organizations together for economy in overhead expenses and for cooperation in health programs. In addition to its work in coordinating the efforts of private health agencies, the council will maintain an inter-organization information service; a health legislative bureau, which will keep track of national and State health legislation and keep council members fully informed on it, and a statistical bureau. It also expects to aid in the development of health educational material and will foster periodic joint conferences among members of the various participating organizations.

On the fifteenth floor of the Penn Terminal Building will be the offices of the American Social Hygiene Association, the National Committee for Mental Hygiene, the National Organization for Public Health Nursing cooperating with the American Nurses' Association and the League for Nursing Education, and the National Tuberculosis Association.

On the sixteenth floor there will be offices for the American Public Health Association, formerly in Boston; the Bureau of Social Hygiene, the Child Health Organization of America, probably the liaison office of the United States Public Health Service, the National Health Council, with the Common Service Committee; the Maternity Center Association, the New York Diet Kitchen Association, the New York Community Service, and probably the American Society for the Control of Cancer.

The Federal Board of Vocational Education already has its New York offices in the Penn Terminal Building, on the fourteenth floor.

Officers of the National Health Council, which not only maintains its offices in New York, but has a national headquarters office in Washington, are: Chairman, Dr. Livingston Farrand; vice-chairman, Dr. Lee K.

Frankel; secretary, Dr. C. St. Clair Drake; acting treasurer, Dr. William F. Snow; acting executive officer, Dr. Donald B. Armstrong.

THE AMERICAN METEOROLOGICAL SOCIETY

The fifth meeting of the American Meteorological Society will be held on April 20 and 21 at the Central Office of the Weather Bureau, Washington, D. C. Including the six papers to be presented at the meeting of Section (c), meteorology, of the American Geophysical Union on April 19, the program as published in the April *Bulletin* of the society contains 27 titles of varied interest. Abstracts of all these papers and of such discussions as may follow them will be published in the *Bulletin of the American Meteorological Society;* and most of the papers themselves will probably be published in the *Monthly Weather Review.*

The proceedings of the first annual meeting of the society at Chicago on December 29, 1920, were published in the January issue of the *Bulletin.* A motion to increase the annual dues from $1 to $2 was lost because of the desire not to curtail the membership merely for money, which could be raised in other ways. A resolution favoring the Weather Bureau's estimates for increased appropriations was passed, but it had no effect in persuading Congress to recognize the dire straits of the bureau with its present program of service. Rather full information about the 32 papers on the scientific portion of the program appeared in the February and March *Bulletins.* Many of these papers have since been published in the *Review.*

Charles F. Brooks,
Secretary

Washington, D. C.

THE EDINBURGH MEETING OF THE BRITISH ASSOCIATION

From *Nature* we learn that for the meeting of the British Association, which will be held in Edinburgh on September 7–14 next, the following presidents of Sections have been appointed: Section A (Mathematics and Physics), Professor O. W. Richardson; B (Chemistry), Dr. M. O. Forster; C (Geology), Dr. J. S. Flett; D (Zoology), Mr. E. S. Goodrich; E (Geography) Dr. D. G. Hogarth; F (Economics), Mr. W. L. Hichens; G (Engineering), Professor A. H. Gibson; H (Anthropology), Sir J. Frazer; I (Physiology), Sir W. Morley Fletcher; J (Psychology), Professor C. Lloyd Morgan; K (Botany), Dr. D. H. Scott; L (Education), Sir W. H. Hadow; and M (Agriculture), Mr. C. S. Orwin. Sir Richard Gregory has been appointed president of the Conference of Delegates of Corresponding Societies. Among the subjects of general interest which are being arranged for discussion at joint sectional meetings are: The Age of the Earth, Biochemistry, Vocational Training and Tests, The Relation of Genetics to Agriculture, The Proposed Mid-Scotland Canal, and The Origin of the Scottish People. The president of the association, Sir Edward Thrope, will deliver his address at the inaugural meeting on Wednesday evening, September 7, and discourses will be given at general evening meetings by Professor C. E. Inglis on The Evolution of Cantilever Bridge Construction, involving a comparison between the Forth and Quebec bridges, and by Professor W. A. Herdman, the present president, on Edinburgh and Oceanography. Measures are being taken towards a more effective coordination of the daily programs in order to avoid the clashing of subjects of kindred interest.

SCIENTIFIC NOTES AND NEWS

Prince Albert of Monaco, sailed on April 9 for New York on his way to Washington to receive the Alexander Agassiz gold medal awarded by the National Academy of Sciences to him in recognition of his promotion of oceanographic research. He will give an address before the academy on the evening of April 25.

Professor Albert Einstein will be the guest of Princeton University from May 9 to 15, and will give five lectures on the theory of relativity. Professor Einstein and Dr. Weiz-

mann have been given the freedom of the City of New York.

Vilhjalmur Stefansson, on motion of the prime minister of Canada, has recently received the thanks of the Canadian government for his public services during the years 1906–1919. The action was based partly on his work in science and in geographic discovery, and partly on his having called to the attention of the country great economic resources in the north that had been previously unknown or undervalued. "He has turned men's minds towards the north country as a possible source of food supply and home for colonists, and his work and advice have proved the greatest incentive in promoting public and private development of our northern resources." For his geographic work, Mr. Stefansson had already received several gold medals from learned societies in America and Europe.

The Boyle medal of the Royal Dublin Society has been awarded to Dr. George H. Pethybridge, botanist of the department of agriculture, Dublin.

Sir William J. Pope has been elected an honorary member of the French Chemical Society.

Dr. H. K. Anderson, master of Gonville and Caius College, Cambridge; Professor W. M. Bayliss, professor of general physiology, University College, London; and Sir William H. Bragg, Quain professor of physics, University of London, have been elected members of the Athenæum Club, London, for eminence in science.

Dr. Solon Shedd, professor of geology at the State College of Washington, Pullman, has been appointed state geologist. Dr. Shedd will retain his position as professor of geology at the State College.

Mr. C. R. DeLong has been appointed chief of the chemical division of the U. S. Tariff Commission, succeeding Dr. Grinnell Jones, who has returned to Harvard University, but retains a connection with the commission in an advisory capacity. The other members of the chemical staff are: S. D. Kirkpatrick, W. N. Watson and A. B. Willis.

The annual general meeting of the Chemical Society was held on March 17, when, as we learn from *Nature*, Sir David J. Dobbie, the retiring president, delivered his address. The following officers and members of council were declared elected: *President:* Sir James Walker. *Vice-presidents who have filled the office of president:* Professor H. E. Armstrong, Sir James J. Dobbie, Professor W. H. Perkin, Sir William J. Pope, Dr. Alexander Scott and Sir William A. Tilden. *Other Vice-presidents:* Professor F. G. Hopkins, Professor F. S. Kipping and Professor J. F. Thorpe. *Ordinary Members of Council:* Professor J. S. S. Brame, Dr. C. H. Desch, Mr. E. V. Evans, Mr. H. B. Hartley, Dr. T. S. Patterson, Dr. T. Slater Price, Mr. W. Rintoul, Dr. R. Robinson and Dr. N. V. Sidgwick.

Dr. Walter E. Collinge, of St. Andrews University, has been appointed keeper of the York Museum.

Dr. Colin G. Fink, organizer and for the past four years director of the Research Laboratories of the Chile Exploration Company has resigned his post. Formerly Dr. Fink was in charge of research at the Edison Lamp Works.

Mr. W. M. Smart, Trinity College, chief assistant at the Cambridge Observatory, has been appointed to the John Couch Adams astronomership, recently founded under a bequest by the late Mrs. Adams.

Collier Cobb, professor of geology at the University of North Carolina, Chapel Hill, is on a year's leave of absence under the Kenan Traveling Fund. He is studying shore-lines and shore-line processes in Japan.

Professor Herbert Osborn, of the Ohio State University, has recently returned from a two months' stay in Florida, during which he collected entomological material at different points in the state with cooperation of the State Plant Board of Florida.

Dr. Frank App, of Rutgers College, has been given a year's leave of absence to become sec-

retary of the New Jersey State Council of County Boards of Agriculture.

Friends of Professor Chandler presented in 1910 to Columbia University a sum of money which constitutes the Charles Frederick Chandler Foundation. The income from this fund is used to provide a lecture by an eminent chemist and to provide a medal to be presented to the lecturer in further recognition of his achievements in science. Previous lecturers on this foundation were L. H. Baekeland, W. F. Hillebrand and W. R. Whitney. The lecturer this year will be Frederick Gowland Hopkins, professor of biological chemistry, Cambridge University, England. The Chandler Medal will be presented to Dr. Hopkins in order to recognize his pioneer and very valuable work in the study of food accessories, such as vitamines. Professor Hopkins' subjects will be "Newer Aspects of the Nutrition Problem." His lecture will be in Havemeyer Hall, Columbia University, on the evening of April 18.

Dr. A. J. Lotka, who is working as a guest in the department of biometry and vital statistics of the school of hygiene and public health of John Hopkins University, gave in April a series of four lectures on "The dynamics of evolution and the foundations of physical biology."

Sir Walter Fletcher, secretary of the Medical Research Committee of Great Britain, will deliver the Tenth Harvey Society Lecture at the New York Academy of Medicine, Saturday evening, April 16. His subject will be: "The state's relation to medical activities in Great Britain."

Dr. Herbert Haviland Field, who in 1895 founded at Zurich the Concilium Bibliographicum, died suddenly of heart disease on April 5, at Zurich, where he had lived. He was born in Brooklyn in 1868, graduated from Harvard in 1888.

Dr. Thomas Benjamin Doolittle, of Branford, Conn., said to be the originator of the first telephone switchboard and associated in the organization of the original Bell Telephone Compnay in Boston, died on April 4, at the age of eighty-two years. Dr. Doolittle in 1898 received the Edward Longstreth medal from the Franklin Institute of Philadelphia for developing the process of producing hand-drawing copper wire.

Dr. Alfred Doolittle, professor of mathematics and instructor in astronomy at the Catholic University since 1898, died on February 23.

We learn from the *Journal* of the Washington Academy of Sciences that Mr. Frederic Perkins Dewey, assayer of the Bureau of Mines of the Treasury Department, died on February 10, in his sixty-sixth year. Mr. Dewey after graduation from Yale University became instructor in chemistry at Lafayette College. From 1881 to 1889 he was connected with the U. S. Government, first as chemist with the Tenth Census, then as mineralogist with the Geological Survey, then as curator in the National Museum. After 24 years in chemical and metallurgical patent practise he became assayer of the Mint in 1903.

Dr. E. Béraneck, professor of biology at the University of Neuchâtel, has died at the age of sixty-one years.

The death is also announced of Dr. León Becerra, chief health officer of Guayaquil, Ecuador, a member of the Rockefeller commission studying the yellow fever situation.

A course of four public lectures on the history of plant delineation was given during March in the botany department of University College, London. The first two, on the art of the ancient empires and the dark and middle ages, was delivered by Dr. Charles Singer, and the other two, bringing the subject down to recent times, by Dr. Agnes Arber.

The United States Civil Service Commission announces an examination for the position of scientific assistant in the U. S. Bureau of Fisheries at $1,200 (plus $20 a month), to be held on April 27. Applicants will be rated chiefly upon zoology in its relation to the fisheries, and general biology.

A regular meeting of the American Physical Society will be held in Washington, at

the Bureau of Standards, on Saturday, April 23. If the length of the program requires it, there will also be sessions on Friday, April 22. Other meetings for the current season are as follows: August 4, 5, Pacific Coast Section at Berkeley; November 25, 26, Chicago, December 27–31, Toronto, annual meeting.

Penikese Island, Buzzards Bay, was abandoned as a leper colony on March 10. The thirteen lepers on the island with three from Bridgeport, Conn., and two from Richmond, Va., were transferred to the federal leprosarium recently established at Carville, La.

UNIVERSITY AND EDUCATIONAL NEWS

A building plan for its medical school in Chicago has been adopted by the University of Illinois in cooperation with the state department of public welfare. What was formerly a ball park, just south of the Cook County Hospital, Chicago, is to become the campus. The buildings now under construction are a clinical institute, a new building for the Illinois Charitable Eye and Ear Infirmary, a psychiatric institute and an institute for crippled children. Later, the clinical institute and the orthopedic institute will be enlarged and additional buildings will be erected for infectious diseases, venereal diseases, a research institute, a library, class rooms, research laboratories and a dental institute. The Elizabethan style of architecture has been selected.

The Senate of the University of London has adopted a resolution to continue the physiological laboratory at South Kensington until the end of 1923.

Dr. L. Emmett Holt, Carpentier professor of the diseases of children at the College of Physicians and Surgeons, Columbia University, has resigned this chair and the administrative conduct of the department, and has been appointed chemical professor of the diseases of children.

At the Harvard Medical School Dr. Philip Drinker, of the Buffalo Foundry and Machine Co. and Dr. Douglas A. Thom have become instructors of applied physiology and psychiatry, respectively. Dr. Frederick L. Wells, director of the Psychological Department of the Psychopathic Hospital, Boston, has been given an appointment as instructor in experimental psychopathology.

Mr. F. C. Thompson, Sorby research fellow of the Royal Society, has been appointed to the chair of metallurgy in the University of Manchester.

DISCUSSION AND CORRESPONDENCE

POSITIVE RAY ANALYSIS OF LITHIUM

Applying the method of positive ray analysis previously used[1] to the element lithium, I have recently found that it is composed of two isotopes. With positive ions from heated lithium salts G. P. Thomson and F. W. Aston have also obtained two components.[2] In my experiments the metal itself was evaporated in a small iron capsule, heated electrically. The two rays corresponding to atomic weights 6 and 7 were widely separated and appeared simultaneously as the heating current was increased. The absolute atomic weights could be checked by comparison with hydrogen atoms which were driven off from the metal; the setting on the maxima of the two components was so accurate that assuming a molecular weight of exactly 6 for the lighter, the heavier atomic weight was 7.00 within 2 units in the second decimal place, thus excluding the possibility of a simple element with the chemical atomic weight 6.94. Any further isotopes at 4, 5, 8 or 9 must be less than 2 per cent. of that at 7.

It was also observed that the proportion of the two components varies with the experimental conditions. The lighter at 6 is sometimes one quarter as strong as that at 7, but under other conditions of heating and pressure, it appears weaker and sometimes is only one twelfth as strong. To obtain a mean atomic weight of 6.94 the lighter should be only one sixteenth as strong as the heavier,

[1] Science, December 10, 1920.

[2] *Nature*, February 24, 1921.

but it has always been found stronger than that. This variability is of interest as showing that there are differences in the properties of the two isotopes, and of course the effect of mass differences should be specially evident, on account of the large mass ratio 6 to 7, in the case of lithium.

A. J. Dempster
Ryerson Physical Laboratory,
University of Chicago

A REMEDY FOR MANGE IN WHITE RATS

A simple method of keeping white rats for experimental work free from mange has been successfully used for some time in this laboratory. Sore ears, noses and tails are quite common in rat colonies and are not caused by deficient rations, as is often thought, but by a parasite known as the *Notoedres alenis*.[1]

The lesions on the ear, due to the mange produced by this parasite, are very characteristic, causing the whole ear to swell and become inflamed with the outer edge of the ear fringed with a cauliflower-like incrustation. On the tail the lesions resemble those on the ear, while on the nose they frequently take the form of horn-like protuberances. These lesions can be readily differentiated from other lesions by the application of insecticides. We have found that pine oil[2] applied with a soft brush will heal affected parts very quickly. This oil has not only very healing properties, but also strong antiseptic and anesthetic properties. Because of the latter care must be exercised in its application.

Since learning of the effectiveness of this oil it is the custom in this laboratory to wash our animal cages once a week with hot water and soap and to spray the sawdust used on the floor of the cages with the oil. In this way all lice and parasites which are ordinarily troublesome pests in animal colonies are kept down to minimum. If an individual rat becomes infested with lice it can be sprayed with the oil. An atomizer is used for this purpose.

Cornelia Kennedy
Minnesota Agricultural Experiment Station

[1] Private communication of Dr. B. H. Ransom, Bureau of Animal Industry, to Dr. J. E. Foster, formerly with the Mayo Clinic.

[2] The pine oil used for the experiments was furnished by the Newport Company of Pensacola, Fla., through the courtesy of R. C. Palmer, chief chemist.

IMPOSSIBLE (?) STORIES

Dr. Campbell's astonishment at the actual occurrence of the Mark Twain incident (March 4) "reminds me." I had looked upon the Irishman's astronomy as related by DeMorgan[1] as a good "manufactured" story.

Long life to the moon for a dear noble cratur
Which serves for lamplight all night in the dark,
While the sun only shines in the day which by natur
Wants no light at all as ye all may remark.

I was astonished to hear Dr. W. C. Farabee, of the University Museum, relate that in his South American expedition he found the Shipibos Indians worshipping the moon and that upon inquiry they gave the same reason as the Irishman.

Samuel G. Barton
University of Pennsylvania

[1] "Budget of Paradoxes," p. 242, 2d ed.

QUOTATIONS

INTERNATIONAL SCIENTIFIC ORGANIZATION

There is much to be said in favor of "teamwork," the concentration of many experts on a single problem or on one aspect of a problem. Some inquiries are so vast in scale that progress on any other lines can not be expected.

The modern telescope has made known the existence of myriads of stars beyond those visible to the unassisted eye. The counting and classification of this multitude can be achieved only by the concerted patience of many men in many countries, and may yet form the basis of some new conception of the order of the universe. Meteorology and geodesy, the attempt to plot the shape of our earth from a number of long base lines, must be international. The determination of standards is of little use unless it lead to universally agreed methods and results. The development and control of fisheries, the ap-

pointment of close times, and the protection of breeding areas require cooperation.

Many minor problems, such as the study of variations in human anatomy, can be advanced most quickly if all the opportunities in different countries are employed simultaneously on a selected object. Such examples could be multiplied indefinitely. International team-work is required sometimes merely as the quickest means of attaining the object, sometimes because no other method is possible, sometimes because common practical interests are involved.

Before the war international scientific cooperation was obtained in several ways. As many as 40 to 50 international bodies had come into existence in response to the need. Some were sustained by formal conventions arrived at through the usual diplomatic channels; others were due to the efforts of individual scientific societies or interests; many were the informal result of personal effort directed to a common purpose. All these were rudely interrupted by the clash of arms, and much water will have to pass under the bridges before the healing process has been completed. But it has already begun.

Through the booksellers work published during the war is creeping across the frontiers; the impersonal exchange of publications has been resumed between many of the learned societies; there has even been a little furtive correspondence between individuals. Science could not wait. The theory of Einstein, the German Jew, was put to the test by British astronomers; physiologists and doctors here and in Germany had to use the same methods of research in struggling against the same problems of altered nutrition and of damaged men, and could not let their service of humanity be restricted by a local patriotism. Had it been allowed to take its natural course, this cold, almost stealthy redintegration would have offended no one and would, indeed, have assisted towards the open internationalism which we must all hope for our sons or sons' sons, although we can not even wish it for ourselves.

But there were the formal conventions. On these descended a little group of diplomatists of science, almost as aloof from the real feelings of those whom they claimed to represent as the big men of the Peace Conferences. They held a conference in London in October, 1918, when every one except themselves knew that the war was almost over. They resolved, good people, that it "was desirable that the nations at war with the Central Powers should withdraw from the existing conventions relating to International Scientific Associations in accordance with the statutes or regulations of such conventions respectively, as soon as circumstances should permit," and that "new associations, deemed to be useful to the progress of science and its applications, be established without delay by the nations at war with the Central Powers with the eventual cooperation of neutral nations."

Then came the armistice and then, after an interval so long that impersonal relations with our former enemies had begun to be resumed, came the Peace Treaty. By that the Germans undertook to withdraw from most of the scientific conventions. Nevertheless, so far as the Allies and neutrals were concerned, these remained in existence. The same group of amateur diplomatists called a conference at Brussels larger in numbers but equally unrepresentative in character. This conference proceeded to destroy the last remnants of existing international cooperation. First they withdrew themselves from all the conventions; next they excluded all the Central Powers; thirdly they excluded all the neutrals. Having thus created chaos, they proceeded to the elaboration of a scheme of superorganization almost pathetic in its sterile incompetence.

The basis of the wonderful edifice is an International Research Council. This is to be the supreme body in all the affairs of science, to coordinate international efforts, to initiate new international unions, to direct international activity and to negotiate with governments. Its constitution is to remain in force for ten years and all subordinate

unions or associations are to comply with its statutes. Of these the vital clause is that membership is to be limited at first to what were the Allied countries during the war but that countries then neutral may be admitted if they obtain a favorable majority of not less than three-quarters of the countries already in the Union. It appears to be the case that former enemy countries if they choose to plead for admission and can obtain a three-quarters majority are also eligible, but there is dispute as to the interpretation of the phrases. In any event the scheme perpetuates for ten years the division of the nations into the groups of war with the addition that former neutrals are asked to desert their neutrality and join the Allied scientific combine.

The legal domicile of the new supreme body is to be at Brussels where the funds are to be kept, and triennial general assemblies are to be held. An executive committee consisting of five members (a "big five") is to direct the affairs of the Research Council between the meetings of the Assembly. All the branches of science are invited to form international unions with their statutes in agreement with those of the Research Council.

The organization is actually in existence and several of the subordinate international unions have been formed. But how far these have any real significance or vitality it is more difficult to say. The statutes laid down that a country could join the International Research Council or any Union connected with it through its principal academy, its national research council, some other national institution or association of institutions, or through its government.

It is therefore clearly within the power of bodies without a direct mandate from scientific men as a whole to make their countries formal participants. British biologists, for example, have formally refused to join an International Biological Union on the double ground that the complex organization will hinder rather than help cooperation, and that the constitution perpetuates international divisions which should be left to time to heal. But the promotors of the scheme are making efforts to create a "National Council" which could then enter the new edifice by a back door. No clear statement has been published as to the action of other countries, but evidence accumulates as to the absence of real support for the scheme of super-organization.—*The London Times.*

The issue of the *Times* published on March 8 contains an article headed "The Progress of Science; Revolt against Super-Organization." A few words of comment are necessary, though the task is disagreeable owing to the general tenor of the article, which in parts is frankly abusive and in others misleading. Its chief invective is directed against the International Research Council. This, according to the author, is to be "the supreme body in all the affairs of science," and he follows up this product of his imagination by enumerating in the same sentence the avowed objects of the International Research Council, placing a pure invention of his own in juxtaposition to the actual functions of the body concerned so as to leave the impression that both have equal authority.

The International Research Council was founded in the first instance through the action of the Royal Society and the Academies of Paris, Italy, Brussels and Washington. Its object was to reorganize international work which had come to a standstill through the war, and to extend it where found desirable. The question as to the time at which former enemy countries should be admitted is a matter for argument, and it may be the policy of the *Times* to urge their immediate inclusion in the interests of the general peace of the world. Recent incidents at a meeting in Paris at which a German professor took part do not confirm this view, but the question has had nothing to do with the purpose which the writer pretends to discuss. It should not be forgotten, however, that a friendly personal intercourse is an essential condition of the success of international conferences. This is recognized by the countries neutral during the war, which have nearly

all accepted the invitation of the International Research Council to take part in this common enterprise.

The International Research Council has initiated the formation of unions for the conduct of scientific work. In the subjects of astronomy, geodesy and geophysics, and chemistry such unions are actually at work, and two others have been formed. Once an international union is established it becomes autonomous, and conducts its work without interference from the International Research Council except in a few matters in which a common policy is desirable.

Every one knows that the decisions of an international conference are only advisory, and have no binding force on the separate countries. Representatives taking part in the conference report to the home authorities concerned, who act as they think fit, accepting, no doubt, in general such recommendations as have secured practical unanimity. At a recent meeting in Brussels certain countries desired to initiate the formation of an International Union of Biology, and their representatives tentatively drew up some statutes. These were submitted to a competent body in this country, which reported unfavorably, and there the matter ends so far as Great Britain is concerned. This does not, of course, prevent France, Italy, the United States, and other countries from forming a Union of Biology if they wish. I fail to understand where the grievance of the *Times* comes in.—Arthur Schuster, General Secretary of the International Research Council, in *Nature*.

SCIENTIFIC BOOKS

THE TERRESTRIAL LIFE ASSOCIATED WITH THE COALS OF NORTHERN FRANCE

In a large, very detailed, and well-illustrated memoir published by the French Ministry of Public Works,[1] Dr. Pierre Pruvost of the University of Lille Museum, has given us the most extensive work so far published on the fresh-water and land invertebrates of the Coal Measures of northern France, that is, of the Westphalian, the equivalent of our Pottsville and Allegheny series. The memoir is based on the "documents preserved in the museum of the University of Lille . . . which never could have been brought together without the cooperation of the mining engineers and the scientific men who are exploiting the basin of the north," and its object is so to define the faunal zones as to give to these same mining men fixed points from which they can reckon the stratigraphic position of their coals.

From the 17 species heretofore known in the fauna, the number is now increased to 116, 54 of which are new. They represent the following classes: 13 bivalves, 1 tubiculous annelid, 6 ostracods, 5 phyllopods (3 new), 3 Malacostraca, 2 Syncarida, 53 specifically determined insects (43 new), 1 eurypterid, 3 limulids, 7 spiders (3 new), 4 sharks, 6 crossopterygians (2 new), and 12 ganoids (3 new). These forms are found in 6,970 feet of Westphalian strata, divided into 5 formations and 9 members, most of which are of fresh-water origin, since it is only in the lower 2,350 feet that there is occasional evidence of the sea, this being most decided near the base.

The common fossils with limited ranges and therefore of value in correlating the various horizons are shown to be (1) the bivalves (*Carbonicola, Anthracomya, Naiadites*), (2) the phyllopods (*Estheria, Leaia*), and (3) the scales and teeth of fishes. The ostracods *Carbonia* and *Cypridina* and the annelid *Spirorbis* are all long-ranging, while the insects, even though they are of very short range—in fact, but very few forms extend through more than one zone—occur too rarely to be useful in detailed stratigraphy, other than of a local basin. It is interesting to note that the fresh-water life has in its time duration about the same zoning value as the plants, and that both classes of organic evidence lead to the making of the same general time divisions. With these results attained, the author then paral-

[1] "Introduction à l'Étude du Terrain Houiller du Nord et du Pas-de-Calais. La Faune Continentale du Terrain Houiller du Nord de la France. Mémoires pour servir à l'explication de la carte géologique détaillée de la France," pp. 584 (quarto), 29 pls., 51 text figs., Paris, 1919.

lels the different coal beds of northern France with those of Belgium and England.

The greater part of the volume is taken up with the insects (pp. 93–321), and the author confirms Handlirsch's conclusion that during Westphalian time hexapods were large, in fact, that as a rule they were "giants." Pruvost thinks that the Westphalian insects were not all carnivorous, but that some may have fed on the pollen, etc., of plants like the cordaites and cycadophytes; in other words, that the rise of the insect world was largely conditioned by the development of inflorescence among plants.

Insect impressions, to be preserved in the rocks, must be entombed in the very finest of sediments. The author states that they are found only in shales, in association with delicate plant remains, and with those of animals as well. The very best ones, of rare occurrence, have, however, suffered no appreciable transport or maceration, but were buried quickly along with the most fragile plants in the softest of muds; while the majority of the specimens found commonly in the "insect beds" have undergone more or less long periods of floating, and consequent maceration and dissociation. The floated specimens occur at times with stronger plant fragments and the remains of animals, all in varying degrees of decomposition.

Pruvost breaks up Handlirsch's order Protorthoptera, and puts the majority of his families in a new suborder, the Archiblattids (3 species described), which are present as early as the base of the Westphalian. These are "the simplest and oldest of Protoblattoidea" and they may have had their origin in the Paleodictyoptera, the original source-stock of all insects. Two other suborders of Protoblattids are erected, Mimoblattids (for American forms) and Archimantids (1 described). The author remarks on "the homogeneity and antiquity of the blattid phylum," describing 43 forms, and on its early separation from the rest of the orthopterids. Of Paleodictyopterids he describes but 3 forms. He believes that the greatest evolution of Paleozoic insects took place during the Westphalian, and states that at the top of the Lower Carboniferous (Dinantian or Mississippian) but one order is known; early in the Westphalian three orders are "scarcely outlined"; and at the end of the Westphalian "almost all the Paleozoic phyla are fully established."

> The evolution of insects was especially rapid at the base of the Westphalian (Flines member), again at the base of the upper part of the same series (Ernestine), and at the top of the Westphalian in the Edouard member. And this threefold acceleration in insect evolution is in harmony with the floral enrichment.

We must add here that the supposed insects found in the Horton formation (early Mississippian) of New Brunswick, Canada, and mentioned in the table opposite page 293, have been shown to Professor H. F. Wickham and Dr. David White, with the result that both paleontologist and paleobotanist agree that they are not insects but the carbonized fragments of woody plants.

To the young author, a favorite student of Professor Barrois under whose direction are being carried out a series of studies designed to apply the "paleontologic method" to the problems of the coal basin of northern France, are extended our congratulations on his great achievement.

Charles Schuchert

SPECIAL ARTICLES

THE RELATIVITY SHIFT OF SPECTRUM LINES

Three experimental tests of Einstein's Relativity Theory of Gravitation have been proposed. Two seem to have been verified experimentally. The third, the predicted shift of solar spectrum lines, is still very much in dispute. Evershed and Royds,[1] and Schwarzschild[2] obtained very discordant results. St. John,[3] with very fine apparatus, also obtained very discordant results with however a zero effect, on the average. Grebe and Bachem[4] at first obtained discordant results, but a more careful analysis of their

1 Bulletin 39, Kodaikanal Observatory.

2 *Sitzungsberichte*, Berlin Akad., p. 1201, 1914.

3 *Astro. Jour.*, 46, 249, 1917.

4 *Verh. d. D. Phys. Ges.*, 21, 454, 1919.

data[5, 6, 7] yielded more consistent results and results in agreement with theory. Using the lines near the head of the CN 3883 band, the shift of solar wave-lengths, compared to terrestrial, should be 0.0082 Å to the red, equivalent to the Doppler effect of a descending current on the sun of 0.634 km./sec.

It appears to the author that a spectral line must rigidly fulfill three conditions, in order to be suitable for use in this work. (1) It must show no pressure shift, pole-effect, or other variation of frequency with physical condition of the source (excluding gravitational effects), (2) it must be a single, sharp, symmetrical line, (3) it must, in the solar spectrum, be quite free from other "foreign" lines.

Band lines are used because they seem to fulfill condition (1). In the early work proper attention was not paid to condition (3). Grebe and Bachem,[6] by obtaining microphotometric curves, have attempted to rigidly satisfy condition (3), and in doing so have had to discard all but eleven of the 36 lines formerly measured by them. But *no* investigators have made an attempt to rigorously satisfy condition (2). Now the author, in arriving at a new formula for band series,[8] obtained very fine spectrograms of the 3883 band, and made an extended investigation of its structure, supplementing the work of Uhler and Patterson.[9] There are a number of different series in this band (twenty in all, commonly classified as ten series of doublets), but without exception the individual members of the various twenty series are *sharp, symmetrical* lines. This is a noteworthy characteristic of most band series, differentiating them from line series, the members of which are *all* complex, according to the Bohr-Sommerfeld theory. Moreover these latter are quite susceptible to changing electrical conditions.

But the ten doublet series of the 3883 band have different spacing and so are continually crossing, resulting very frequently in an apparent *broad, unsymmetrical* line, even with the best resolving power at our disposal. But this *complex* is really only the superposition, or partial superposition of two or more *sharp, symmetrical* lines. It is self-evident that the *apparent* center of gravity of such a complex depends on the length of exposure, etc., while the position of the "peak" of a micro-photometric curve depends on the relative intensity and position of the component members of the complex. It is known that the relative intensity of certain series in the 3883 band changes with physical conditions, and there is evidence that their relative intensity in the sun is *different* from that in the ordinary carbon arc. Hence any apparent "line" which is really a *complex* is entirely unsuitable for the detection and measurement of so small a shift as that predicted by Einstein. This is especially true as the solar lines are in absorption, while the arc lines are in emission.

The author, in his analysis, has identified many series lines, not previously identified, and by obtaining accurate formulæ for the stronger series, has been able to compute "theoretical" positions for all lines of these series, including those entering into complexes. In all cases tested, the actual appearance of the complex was in agreement with the theoretical structure thus built up. Also, many complexes have been recognized which may not previously have been suspected as such, and the presence of several extraneous lines in the normal arc spectrum (carbon lines, but not band lines) has been detected. Thus material is at hand for a rigid investigation of the eleven lines finally used by Grebe and Bachem. The details of this work will be published elsewhere. Only the results are given here.

Of the eleven lines only *two* (λ 3873.504 and λ 3858.822, on the Rowland system) fully satisfy condition (2). Even this is not strictly correct, for the two lines are unresolved doublets, the 31st and 49th member, respectively, of the A_1 series. But the two

[5] *Zeit. f. Phys.*, 1, 51, 1920.

[6] *Zeit. f. Phys.*, 2, 415, 1920.

[7] *Phys. Zeit.*, 21, 662, 1920.

[8] *Astro. Jour.*, 46, 85, 1917; *Phys. Rev.*, 11, 136, 1918; 13, 360, 1919.

[9] *Astro. Jour.*, 42, 434, 1915.

components of the doublet (in the case of the hundred or so members which *can* be resolved) are of exactly equal intensity, and therefore it seems safe to assume that the unresolved doublets are at least symmetrical, and to use them. For 3873.504, Grebe and Bachem obtained a shift of 0.58 km. (average of five consistent determinations from different plates), and Schwarzschild 0.45 km. (average of four consistent plates). No other investigators have used this line. For 3858.822, Grebe and Bachem obtained 0.42 km. (average of six consistent determinations), St. John 0.40 (average of four different methods, of which only the first two are wholly independent and so entitled to the most weight, these two, *a* and *b*, yielding 0.46 km.), Schwarzschild 0.39 km. (average of four readings—three consistent).

Using the 0.46 km. value of St. John, these five determinations for the two lines average 0.46 km./sec. In all cases this is the shift between lines radiated by the center of the sun, and by the arc. But St. John (*loc. cit.*) and Adams have both obtained reliable evidence that at the center of the sun there is a rising current of about 0.12 km./sec., compared to the rim.[10] This tends to mask the Einstein effect. The true value of this effect, as experimentally determined, is then $0.46 + 0.12 = 0.58$ km./sec., compared to the theoretical 0.634. While the data are far too meager to draw any final conclusions, it is worthy of notice that the results of *all* observers are truly consistent on *really* good lines. The great discrepancy between St. John's and Grebe and Bachem's general averages has been the puzzling factor, thus far. The author believes that he has a partial explanation for this, and will present it in a later paper, together with a list of lines which are suitable for use, as far as condition (2) is concerned.

It might be added that, for the nine lines quoted by Grebe and Bachem[5, 6] (λ 3858.822 and λ 3851.427 being accidentally omitted), the agreement among different observers is worse than indicated, due to Grebe and Bachem's consistent misquoting of St. John's results, as well as other errors. The correct averages are: G. and B. 0.57, Schwarzschild 0.63, St. John 0.17 (or 0.26 using methods *a* and *b* only), Evershed and Royds 0.67. General weighted average 0.50, or 0.52, using 0.26 for St. John.

If all eleven lines are used, the averages become: G. and B. 0.52 (eleven lines), Schwarzschild 0.57 (nine lines), St. John 0.22 (eight lines, or 0.30, two good methods only), Evershed and Royds 0.67 (two lines). Average (weighted according to the number of lines), 0.46, or 0.48, using 0.30 for St. John. To all these values should be added 0.12 km. to obtain the true rim—arc value.

It should also be added that, in the author's opinion, St. John's method (*c*), and Grebe and Bachem's recent calculation[7] of 100 CN lines add comparatively little weight to the argument, as they involve the use of Rowland's standards. Since Rowland used both terrestrial and solar wave-lengths, in obtaining his table of standard lines, the Einstein shift (if real) is hopelessly involved in the measurements and can not be definitely extricated by any such method as that recently used by Grebe and Bachem.

Raymond T. Birge
University of California

10 Schwarzschild's results indicate a falling current, *not* a rising, as quoted by Grebe and Bachem, but are too discordant to have any value. St. John's are very reliable.

A NEW HIGH TEMPERATURE RECORD FOR GROWTH

A record of growth of young joints of a prickly pear (*Opuntia*) at 50° C. and 51.5° C., and of the active elongation of etiolated stems of the same plant growing at 49° C. was published in 1917. Previously to that time Dr. J. M. McGee had found that the mature joints of the same *Opuntia* might reach temperatures of 55° C. in the open without damage, which was a record for endurance of the higher plants in air.

In the repetition of the growth measurements at the Desert Laboratory late in March, 1921, young joints which might reach tem-

peratures of 49° C. in the sun in an unventilated glass house were heated further by the use of electric grills. Temperatures were taken by mercurial thermometers with bulbs of the clinical type thrust into joints within a few centimeters of the one being measured, but which had equivalent exposure.[1]

The elongation of the joints during this youngest stage is directed by the temperature, and the retardations due to maximum night transpiration and acidity which come in later are not yet manifest. The rate of elongation therefore is greatest in midday and early afternoon. Such a joint showing a temperature by the inserted thermometer of 43.5° C. was subjected to the additional heating of the electric grill at 1:30 P.M. At 2 P.M. the temperature passed 51° C. with growth still in progress, the rate but little lessened from that of 1 mm. in 24 hours which it was showing at the beginning of the test. The temperature was now raised slowly until 3 P.M. the joint stood at 51.5° C., the maximum at which growth had ever been observed in any seed plant. At 3:10 a temperature of 54.5° C. was reached and five minutes later the readings were 55.5° C. The joint was kept for an hour between 55° and 55.5° C. during which time the auxograph tracing showed a retardation but not a stoppage of growth. The heat was shut off, the temperature soon falling to 42° C. and to 19° C. at 9 P.M., when the record assumed the character of that of the preceding day of the same joint and of a similar one standing near it.

A repetition of the tests was made next day at 10 A.M. when the joint stood at 33.5° C. The heaters were brought into action, the joint reaching 55° at 10:45 A.M. The preparation stood in the sun and was under normal conditions of ventilation and transpiration. Readings of 54.5° C. to 55.5° C. were made for a period of an hour and a half during which period the elongation was 0.2 mm. or near the maximum rate for the species and was still continuing. One heater was removed at 12:15 midday and ten minutes later the joint had fallen to 49.5° C. The cooling had resulted in a minute reverse movement of the auxograph recording lever of a character which could only be attributed to the contraction of the metal and clay of the setting. The temperature of the joints had fallen to 32° C. by 3 P.M. with no noticeable diminution of the rate, the maximum being taken to lie at some point over 40° C.

A comparison of the thermometer with U. S. Bureau of Standards No. 7618 gave an error so small as to be negligible with regard to the above data. Furthermore the young joint continued its growth at a rate normal to its developmental stage.

These and previously published measurements establish the following points:

1. Growth in *Opuntia* may begin at 9° C. and extend to 55° C.

2. Young joints of *Opuntia* may endure the maximum of 55° C. observed in mature joints in midsummer, for periods of an hour and a half, resuming elongation at lower temperatures with no perceptible after-effects.

3. A new high record for growth in *Opuntia* and for the higher plants of 55° C. (131° F.) has been established by these experiments.

4. The maximum rate of growth of *Opuntia* occurs between 37° C. and about 47°–49° C., under which conditions a biocolloid consisting of 9 parts agar and 1 part protein undergoes maximum swelling in water.[2]

5. The cell colloids of *Opuntia* include a large proportion of pentosans or mucilages, the colloidal condition of which is in general less affected by the temperatures used than albuminous substances. It is to be noted however that bacterial cells, which are highly albuminous, may withstand high tempera-

[1] MacDougal, D. T., and H. A. Spoehr, "Growth and Imbibition," *Proc. Amer. Phil. Soc.*, 56, 289–352, 1917. McGee, J. M., "The Effect of Position upon the Temperature and Dry Weight of Joints of *Opuntia*," Carnegie Inst. Wash. Year Book for 1916, p. 73. MacDougal, D. T., "Hydration and Growth," Carnegie Inst. Wash. Pub. 297, 1920. DeVries, H., "Matériaux p. l. connaisance d. l'influence d. l temperature s. l. plantes," *Arch. Néerlandaises*, III., p. 3, 1870.

[2] MacDougal, D. T., "The Relation of Growth and Swelling of Plants and Biocolloids to Temperature," *Proc. Soc. Exper. Biol.*, 15, 48–50, 1917.

tures, such as those of boiling water. The presence of salts or other compounds may be accountable for the resistance of the proteins to high temperatures.

D. T. MACDOUGAL

DESERT LABORATORY,
TUCSON, ARIZONA,

THE AMERICAN MATHEMATICAL SOCIETY

THE two hundred and fourteenth regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, February 26, 1921, extending through the usual morning and afternoon sessions. The attendance included thirty-five members Ex-president H. B. Fine occupied the chair. One hundred and fifteen new members were elected, and twenty-four applications for membership in the society were received.

The council voted to accept the invitation to affiliate with it extended to the society by the American Association for the Advancement of Science.

Professor E. B. Van Vleck was appointed representative of the society in the division of physical sciences of the National Research Council, to succeed Professor H. S. White. The final report of the committee on membership and sales was presented by its chairman, Professor E. R. Hedrick; in all one hundred and thirty-two applications for membership have been received through this very efficient committee. Questions having arisen concerning dues of foreign members, concerning sales and exchanges of publications with foreign societies and libraries, and concerning individual or concerted efforts to aid foreign journals, a committee was appointed by the council to consider these and related problems.

A letter was read to the council from ex-secretary F. N. Cole donating to the society the sum which accompanied the testimonial tendered him at the preceding meeting of the society in recognition of his very distinguished services. It was voted that the council accept the gift and extend to Professor Cole its heartiest appreciation of his generosity; it was further voted that this fund shall constitute, and be designated as, the Cole Fund. A committee was appointed to consider the use to which the income can best be devoted. The council approved the suggestion that the present volume of the society's *Bulletin* be inscribed to Professor Cole.

A letter of felicitation was sent to [illegible] Mittag-Leffler, of Stockholm, on the occasion of the seventy-fifth anniversary of his birth.

The following papers were read at this meeting:

Coefficient of the general term in the expansion of a product of polynomials: L. H. RICE.

The mathematical theory of proportional representation, with a substitute for least squares: E. V. HUNTINGTON.

On the apportionment of representatives: F. W. OWENS.

On the polar equation of algebraic curves: ARNOLD EMCH.

Generalization of the concept of invariancy derived from a type of correspondence between functional domains. Second proof of the finiteness of formal binary concomitants modulo p: O. E. GLENN.

Concerning the sum of a countable number of point sets: R. L. MOORE.

On the simplification of the structure of finite continuous groups with more than one two-parameter invariant subgroup: S. D. ZELDIN.

Periodic functions with a multiplication theorem: J. F. RITT.

Note on equal continuity: J. F. RITT.

Expressions for the Bernoulli function of order p: I. J. SCHWATT.

The expansion of a continued product: I. J. SCHWATT.

Method for the summation of a family of series: I. J. SCHWATT.

Note on the evaluation of a definite integral: I. J. SCHWATT.

A property of the Pellian equation with some results derived from it: JOHN MCDONNELL.

A necessary and sufficient condition that the sum of two bounded, closed and connected point sets should disconnect a plane: ANNA M. MULLIKIN.

Some empirical formulas in ballistics: T. H. GRONWALL.

Summation of a double series: T. H. GRONWALL.

A geometrical characterization of the paths of particles in the gravitational field of a mass at rest: L. P. EISENHART.

The equations of interior ballistics: A. A. BENNETT.

The next meetings of the society will be at Chicago on March 25 and 26, and at New York, in April.

R. G. D. RICHARDSON,
Secretary

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SHERBURNE WESLEY BURNHAM, 1838–1921

We record, with deep regret at his passing, but with high appreciation of his long and valuable service to astronomical science, the death of Sherburne Wesley Burnham, *emeritus* professor of practical astronomy at the Yerkes Observatory, of the University of Chicago.

Born on December 12, 1838, in the upper valley of the Connecticut, at Thetford, Vermont, Mr. Burnham had the ordinary advantages of the district school, supplemented by some study in the local academy, but he did not go to college. He became an expert stenographer and shorthand reporter, long before the days of the typewriter, and this was his profession for some thirty years. During the Civil War he served in his professional capacity with the Union Army while it was occupying the city of New Orleans. He came to Chicago, after the close of the war, and became attached to the United States Courts.

His interest in astronomy must have developed very early in the sixties, for he purchased his first telescope during a visit to London in 1861; and in 1870 he became the possessor of a fine six-inch refractor, a masterpiece of Alvan Clark, which he had ordered in 1869. Mr. Burnham's vision was extraordinarily keen, for among the 451 new double stars which he discovered with that instrument many were found by other observers to be extremely difficult to resolve with much larger instruments.

In 1873 and 1874 he sent five lists of new double stars to the Royal Astronomical Society, which were published in the *Monthly Notices.* At first he had no micrometer, and was obliged to give estimated angles and distances. A correspondence developed with Baron Ercole Dembowski, who gladly made

the micrometric measurements, with his excellent skill, using a refractor of 162 mm. aperture at Gallarate, in Italy. Two lists covering 136 new double stars were printed in the *Astronomische Nachrichten* in 1875 and 1876. A short list followed in the *American Journal of Science* in 1877 and in *Monthly Notices* for the same year. In 1879 his new doubles from Nos. 483 to 733 were published in the forty-fourth volume of the *Memoirs* of the Royal Astronomical Society, together with micrometric measures of 250 other stars.

During the years from 1877 to 1881 and 1882 to 1884, Mr. Burnham had the use of the splendid 18½ inch Clark refractor of the Dearborn Observatory, then set up in the tower attached to the old Chicago University.

In 1879 he was requested by the trustees of the Lick Trust to test the conditions on Mt. Hamilton. He took his 6-inch refractor, now equipped with circles and a driving clock, to Mt. Hamilton and made observations from August 17 to October 16. His highly favorable report settled the choice of Mt. Hamilton as the site for the Lick Observatory. In 1881 he went again to Mt. Hamilton, by request, and observed the transit of Mercury with the 12-inch telescope.

During some six months of 1881 he was astronomer, under E. S. Holden, at the University of Wisconsin, where the 15.5-inch telescope of the Washburn Observatory had recently been erected. While there he discovered and measured 88 new double stars; and he measured a large number of double stars "Selected from his MS. General Catalogue of Double Stars, as specially needing observation." These observations appeared in Vol. I. of the *Publications of the Washburn Observatory* in 1882. Mr. Burnham's famous 6-inch refractor ultimately become a part of the equipment at Madison.

On the inauguration of the Lick Observatory in 1888, with Professor Holden as director, Mr. Burnham received the appointment as astronomer, and thus had abundant opportunities for the use of the great 36-inch Clark refractor for the continuance of his work. At the Lick Observatory he introduced the principle of using the telescope for all it was worth while the sky permitted: in other words, no part of the night when the sky was clear was given up for any bodily weariness of the observer. In 1892, owing to certain conditions at Mt. Hamilton which were unacceptable to Mr. Burnham, he returned to Chicago, where he was offered the highly responsible position of Clerk of the United States Circuit Court. Incidentally he was receiver of the Chicago and Northern Pacific Railroad Company from 1897 to 1902.

Mr. Burnham was in charge of the expedition from Lick Observatory to observe, at Cayenne, the solar eclipse of December 21–22, 1889. Good results were secured, due in no small measure to Mr. Burnham's large experience in photography. The report was written by Burnham and his associate, Mr. Schaeberle, and published in 1891 in a small volume from the Lick Observatory.

On the inauguration of the Yerkes Observatory in 1897, Burnham became an active member of the staff, making his observations throughout the nights of Saturday and Sunday and returning to his duties in the court on Monday morning. In 1902 he resigned his position with the court, despite the life tenure of that office. This gave him more time for his astronomical studies, but he still retained his residence in Chicago, coming to Williams Bay for observations on two nights in the week. He became Professor *emeritus* in 1914, at the age of 75, the statute of the University of Chicago requiring retirement at 70 having thus far been waived in his case. Although the opportunity for using the 40-inch telescope still remained open to him as before, he hardly availed himself of it, and his last observations here were made on May 13, 1914.

Vol. II. of the *Publications of the Lick Observatory* contain his observations from August, 1888, to June, 1892, and his fourtenth to nineteenth catalogues of new double stars discovered at the Lick Observatory in that period, including the numbers from β 1026 to β 1274. The search for new doubles was made chiefly with the excellent 12-inch telescope. He also found some new nebulæ,

and measured the positions of numerous planetary nebulæ which are given in the same volume. His orbits for several of the more interesting systems on which he had been working appear at the end of that volume. It will be seen that Mr. Burnham had largely given up the search for new double stars while at the Lick Observatory, regarding it as more important that accurate observations should be made of the systems already discovered, particularly those for which large instruments were necessary.

Vol. I. of the *Publications of the Yerkes Observatory,* issued in 1900, is entitled "A General Catalogue of 1290 Double Stars Discovered from 1871 to 1899 by S. W. Burnham." It gives in order of right ascension the history of all of the Burnham stars up to β No. 1290. Aside from his own observations, it summarizes the results of all other observers of these stars and gives diagrams and orbits, by the author and others, of several interesting systems. He did not allow himself to be distracted from his specialty by the allurements of other fields of observation: it was seldom that he looked at nebulæ unless there were double stars to be measured therein; and he had no time for observing comets, however interesting. He made an exception in locating Halley's comet on September 15, 1909, two nights after it had been first caught on a photographic plate by Wolf at Heidelberg: thus Burnham's eye was the first to see the comet, then an extremely faint speck, on this return to perihelion.

During the beginning of Mr. Burnham's use of the 6-inch telescope, he felt the great need of a single catalogue of all double stars in the Northern Hemisphere and he therefore arranged a manuscript catalogue of all known double stars within 121° of the north pole. This was conveniently indexed and proved of great service to the observer. He revised it in two MS. editions, the third of which allowed ample room for expansion and is still in use. The preparation of this catalogue had entailed a great amount of labor, as it was constantly kept up to date. Mr. Burnham says of it that "very few will fully appreciate the enormous amount of hard work which has been necessarily expended in the preparation of such a work. . . . It should be remarked in this connection that with the exception of the four years from 1898 to 1902 all this astronomical work, with the telescope and otherwise, has been done when eight or more hours of at least six days in the week were very much occupied with other and different affairs of life." After his retirement from active observations, Mr. Burnham turned this MS. catalogue and the responsibility of its up-keep over to Professor Eric Doolittle, whose premature death in 1920 is much lamented. From him, by prior arrangement, this passed on to Professor Robert G. Aitken, of the Lick Observatory, who thus carries on the work which will eventually result in a new edition of the "General Catalogue of All Double Stars," now to be mentioned. Efforts had been made for many years to have this great work published, but it could not be brought about until the Carnegie Institution of Washington in 1905 undertook to publish it. The composition was done with great care by the University of Chicago Press, and Part I. was published before the close of 1906. It lists 13,665 double stars and summarizes the numerical information about them, in a quarto volume of 275 pages. Part II., of 1,086 pages, gives details of all important observations of the pairs, with many diagrams. It constitutes a *magnum opus* of which any scientist could be justly proud.

With the 40-inch telescope of the Yerkes Observatory, Mr. Burnham gave no time to the discovery of new doubles. In fact, he avoided them, if possible, and occasionally mentioned seeing some which he did not record. In recent years he took a good deal of interest in the determination of the proper motions of the brighter stars by micrometrically connecting them with neighboring faint stars, for which a negligible proper motion could be assumed. This work was largely to lay the foundation for a greatly increased knowledge of proper motion in the future. Mr. Burnham realized very fully the great advan-

tage in accuracy that such relative positions, obtained with a telescope of long focus, had over absolute measurements with the meridian circle. His extensive observations in this direction appeared in 1913, in Publication No. 168 of the Carnegie Institution of Washington under the title: "Measures of Proper Motion Stars Made with the Forty-Inch Refractor of the Yerkes Observatory in the Years 1907 to 1912." This is a quarto volume of iv + 311 pages and includes a total of about 9,500 measures.

The great General Catalogue contained Mr. Burnham's otherwise unpublished work at Yerkes from 1899 to 1906. Between 1907 and 1911 six extensive papers of his observations appeared in *Astronomische Nachrichten,* and a final collection of measures in the *Astronomical Journal* in 1918.

It will be inferred that Mr. Burnham was a very systematic as well as industrious observer. The writer recalls his answer, to the usual inquiry of what kind of a night he had had, that he had measured 100 pairs besides setting on a number of other stars which were too close to be separated under the particular conditions of "seeing." It should be remembered that these observations were made with a refractor having a focal length of 63.5 feet, and the accomplishment of so much with so large an instrument implies every economy of time in passing from one object to another. His program was very carefully drawn up and no time was wasted in reversing the telescope, which was always pointed toward the east of the meridian so as to "keep ahead of the game."

Mr. Burnham's experience in the courts gave him a critical view of scientific evidence which is not enjoyed by all scientists. His attitude toward new discoveries, except by men in whom he had confidence, was one of some reserve. It was hard for him to believe that there could exist stars of such short periods as the many found among the spectroscopic binaries; but he ultimately came to believe the results from his confidence in the men who obtained them. In a discussion, his premises were often broad, but his logical processes were usually very accurate, so that the conclusions were sound unless he was too tolerant with his premises.

Although an expert in amateur photography, and fully appreciative of the remarkable pioneer work of his colleague Barnard in various astronomical applications of photography, still Mr. Burnham seemed to have a lingering doubt as to the superiority of modern astrometrical procedure on the dry plate, with the use of rectangular coordinates, as compared with the visual use of the micrometer for position angle and distance.

Of a genial nature, Professor Burnham had many friends, and was devoted to them; his regard for some of the federal judges with whom he had been associated was little short of veneration. He always expected that any astronomer passing through Chicago would call upon him; and at least enjoy his hospitality at luncheon.

The duties of his regular life did not make it possible for him to attend many of the meetings of the so-called learned societies. We do not find a record of his having attended a meeting of the Royal Astronomical Society, of which he was a loyal member from 1874 and of which he was elected an asssociate in 1898. In 1894 he received the Gold Medal of the Society for his researches and the annual address was by the then president, Sir William Abney, who has lately died at an advanced age. The honorary degree of A.M. was bestowed upon Mr. Burnham by Yale University in 1878; the honorary degree of Sc.D. in 1915, by Northwestern University. The Lalande Prize of the French Academy of Sciences was awarded to him in 1904.

The impress left upon his branch of astronomy by Mr. Burnham has been equalled only by his great predecessors, the Struves, Wilhelm and Otto; the Herschels, William and John; and Baron Dembowski—for all of whom he had the greatest admiration, and to the last of whom his "General Catalogue" was dedicated.

Mr. Burnham married in 1868 Mary Cleland, who survives him, with their three sons

and three daughters, together with eight grandchildren.

He had been in feeble health for the past two or three years, and suffered a broken hip from a fall, toward the end of February. He died on March 11, 1921, at his home in Chicago.

Edwin B. Frost

Yerkes Observatory,

THE CENTENNIAL EXPEDITION OF INDIANA UNIVERSITY TO PERU

Between June, 1918, and June, 1919, the Irwin Expedition of Indiana University as a part of its work collected the fishes in the highlands of Peru, particularly in the Urubamba valley from the headwaters at La Raya, elevation 14,150 feet, to Santa Ana, 3,000 feet. This work was done by Dr. C. H. Eigenmann and Miss Adele Eigenmann. Collections were made in the upper Huallaga basin between its headwaters about Cerro de Pasco and Goyllarisquisca down to near Tingo Maria, 1,800 feet, mostly by the present writer. Further collections were made from Lake Junin, 13,500 feet, near Cerro de Pasco, in the Mantaro basin to Huancayo, 10,500 feet, by myself and the Eigenmanns. Collections were also made from the headwaters of the Tarma River at Tarma, 10,000 feet, down to La Merced, about 2,500 feet, by the Eigenmanns. The Irwin Expedition thus collected in the headwaters of the Huallaga and Ucayali Rivers from their sources to the neighborhood of 2,000 feet above sea level.

In May of 1920 I started on the so-called Centennial Expedition of Indiana University to carry the survey of the fish fauna to the lower levels of the rivers of eastern Peru. The expedition was assisted by a grant from the Bache Fund of the National Academy of Sciences, and by the hearty cooperation of the Peruvian government, which provided free transportation and other assistance within Peru.

The writer traveled alone, so far as the English-speaking personnel of the expedition is concerned, depending solely upon local aid. At times help was volunteered by interested individuals or solicited from the local authorities, civil and military. Three weeks of the initial portion of the trip (from the Perené to the Ucayali) were spent in company with Professor J. Chester Bradley and Dr. W. T. M. Forbes, of the Cornell Entomological Expedition.

The plan of the present expedition has been to collect as exhaustively as posible the fishes of a few suitable, representative localities in the basins of the above-named rivers, comprised for the most part within the great Department of Loreto. Entering by Lima, Tarma and La Merced, the writer began where the Irwin Expedition left off two years ago, and crossed to the head of navigation of the Pichis-Pachitea-Ucayali system by the Via Central. Ten days were required to traverse the final 200 kilometers of this atrocious trail. It is an endless succession of mudholes, yet the principal and almost sole means of communication between coastal Peru and her trans-andine provinces.

No real hardship is involved in making this journey, thanks to the series of government *tambos,* or shelter houses, at convenient distances, which cater very well to those who come well recommended. This is otherwise a region entirely devoid of inhabitants.

Ten days were spent at Puerto Bermudez. Two days by canoe brought the party to a point on the Pichis to which the steam mail launch could ascend. Thenceforward travel was chiefly by launches, mail and commercial, which abound in Loreto; the shorter trips into tributary streams and lakes were made in dugouts. A month was devoted to the vicinity of Contamana on the lower Ucayali, a fortnight to the Puinahua and Pacaya, and an equal period to the region of Iquitos. The markets of Iquitos are in season very well supplied with fresh fish of great variety. Another month was spent in cruising the upper Marañon from Iquitos to the Pongo de Manseriche, and the tributaries Tigre and Morona. A three-week sojourn in and about Yurimaguas allowed an examination of the lower Huallaga, the third of four great rivers

of Peruvian Amazonia. I had during the Irwin Expedition collected on the upper portion of this river.

These streams, the Ucayali, Marañon, and Huallaga, are comparable in size to the Ohio at flood stage. All arise in the Andes and form a vast confluent flood plain parallel to the mountains, and 500–600 miles in extent. Though 2,000–2,500 miles from the mouth of the Amazon, this plain is only 400 feet above sea level. In all this stretch there is very little topographic relief. The annual fluctuation in level of the Amazon at Iquitos is 40 feet. The annual inundation therefore extends far inland from the rivers. Large numbers of cut-off lakes (*cochas*) with their connecting *cañas* form a network throughout the system, which becomes one body of water with the coming of winter rains. Most of them are dead-water bayous of varying dimensions. There are almost no brooks—all depressions (*quebradas*) only serving to receive the backwater of the rivers. The smaller tributary rivers vary greatly in their flow at all seasons, fluctuating both with the local rainfall and with the level of the outlet. A stream flowing very rapidly now may display almost no current within a few hours, or vice versa.

The extent of the navigable portion of the streams in Peru is much greater than in most Brazilian streams. Many of the latter are interrupted not far from their mouths by impassible rapids. The Brazilian river basins are sharply separated from each other by chains of hills. To the Loretan the slightest rise is a *cerro*—mountain. Any stretch of terrain not inundated is an *altura*. Every riffle is a *pongo*—rapid. Within the past few years even the redoubtable Pongo de Manseriche, by which the Marañon breaks through its last chain of the Andes, has been passed by no fewer than five steam launches. It has always been risked by raft and canoe.

The above conditions allow many species of fish from the lower Amazon to become distributed to the very foot of the Andes, and throughout oriental Peru. One finds many fishes extending from one extremity of Loreto to the other.

With the annual subsidence of the water there is of course everywhere a local sorting of species according to preferred habitat. Thus in a given stream one may not obtain more than two, three, or half a dozen species at the same time. Rarely are more than this number brought up in a single haul of a seine. (Bates called attention to this fact seventy years ago.) The *cochas* usually produce more species, but spaced pretty well apart. To get them all one must draw the seine many times in various parts of the lake. The common fish that one is obliged to reject may surfeit even one's native helpers. There is a pretty rigid assorting of fishes into river and lake forms, despite the fluvial origin of the lakes, and despite the inundations.

The great diversity of arboreal animals on the land is paralleled in the water by the large number of families of fishes and of aquatic mammals represented. The region is yet virtually tourist-free. One may journey by steamers and launches without seeing much of the teeming life of forest and river, or of primitive human life. Only in the tributary streams, traveling by canoe, does one encounter them. Here the dolphin, manatee, otter, alligator, capybara, tapir, etc., still abound, and one comes surprisingly near seeing all the animals which he had hoped to encounter.

The year 1920 was remarkable for its unusual rainfall. Not only was the curve for the depth of the Amazon at Iquitos higher throughout April and May than for many years, but also throughout the dry season. The lowest stage reached was some seven feet higher than the mean minimum depth.

The exceptional inundation of April and May had destroyed much of the crops. There was a serious shortage of all staples (plantains, beans, yucca, rice, etc.) and considerable hardship among the improvident. At no time were the sand bars of the Marañon or Amazon exposed. This of course affected the fishing industry. Seining was made much more difficult, while throw-net fishing was probably increased, due to the concentration of the *mijanos*, schools of shore fish. Much

of the time the fish had taken to the *monte*, or thicket, when the overflow of *cocha* and *quebrada* reached into the forest. While the fish are in the woods, the Loretan abandons his diet of fresh fish, and resorts to his supply of the dried.

Certain fishes are very abundant. But there is an increasing scarcity of others. The famed *pirarucú* (*paiche* of Peru) has undoubtedly been exterminated from certain regions. In the Chanchomayo dynamiting has greatly reduced the river fishes. The government has now found it possible to prevent the sale of dynamite to the poor thereabout, but has found no way of curbing the practise of dynamiting on the part of the wealthy and influential. Poisoning streams wholesale by means of the crushed root of the native poison plant *cube* is prohibited by law. But this method continues to prevail wherever *cube* is available, notably in the tributaries of the Huallaga, the smaller of which are nearly depopulated of fish.

Some birds are also rapidly becoming scarce, especially the egrets, whose plumes are marketed. Two brothers Hoyle of Contamana have secured recently a government monopoly of the plume trade of the Ucayali. They are bound by its terms to develop the fisheries of the Ucayali, first as a means of rearing fish to feed the egrets, and secondarily for the sake of restocking the streams. How to enforce respect of their charter, and how to develop a fisheries industry from nothing, without experience, are two large problems confronting the concessionaires. They do not seem to regard it a difficult matter to secure a revocation of the American law forbidding the importation of egret to this country.

Seventy years ago Bates predicted the rapid extinction of the turtles of the Amazon. In spite of an enormous consumption of turtles and eggs that has continued from that day to this, they are still very abundant. Petroleum has replaced turtle oil since that time, but turtle eggs, meat, and viscera continue to be favorite articles of food.

An effort was made by the expedition to confirm the widespread urinophilous reputation of the *candirú* (*carnero* of Peru). A Briggs' lead-in trap properly baited was frequently placed in rivers in the hope that it might demonstrate such a tropism. This was never successful. Nor did careful inquiry ever lead to the finding of an authentic case of parasitism of man by this fish. That it is strongly tropic to flesh or blood has been demonstrated.

Politically and economically eastern Peru is in an unpromising state. Its isolation from maritime Peru leads to prohibitive transportation costs in that direction. Thus all the business of the region is thrown to the Amazon. The shipping companies of the Amazon and the commercial houses of Iquitos control the economic life of the country. The country is still so new as to be in its period of destructive exploitation, and by reason of its remoteness can not compete in the world markets on any other basis. Due to the low post-war price of cotton, the people are turning from agriculture to the more or less forlorn hope of developing gold and petroleum.

The *Oriente* of Peru was not found by the writer to be, as we are encouraged to believe, wholly a land of dismal forests, swamps, noxious animals, and fevers. All these elements are present in quantity, certainly, but by no means universally distributed. Only once have I seen a large boa, and very few small snakes. Mr. Mitchell of Yurimaguas states that he has seen but four boas in twenty years' residence in Amazonia. Some rivers, *e.g.*, the Pacaya, are full of alligators, but many rivers have almost none. Only one region visited, that of the upper Marañon, was badly infested with fever. Insect pests were numerous, and of many sorts, but not so intolerable as often represented by travelers.

The realization of Humboldt's dream does not seem imminent. Such difficulties as those of transportation, climate, inundation, and an untaught, unambitions population, must be overcome before Peruvian Amazonia shall come to her own.

William Ray Allen

SCIENTIFIC EVENTS

ILLINOIS STATE PARKS

The following bill was introduced in the House by Mr. Kaufmann on March 8:

Section 1. Be it enacted by the people of the state of Illinois, represented in the general assembly: The Department of Public Works and Buildings shall have control, supervision and management of all state parks, already established or acquired hereafter.

Sec. 2. The department may purchase, lease, receive by donation or devise or take options on tracts of lands suitable for public parks, forests, game and fish preserves, and experiment and investigation stations. The department may also acquire by condemnation proceedings in the name of the state of Illinois under the laws regulating to eminent domain. Such proceedings shall be conducted by the Attorney General at the request of the department.

Sec. 3. From time to time as tracts of land are acquired, the department shall establish public parks, public playgrounds, forests, game and fish preserves, and experiment stations. It shall improve and beautify such tracts of land and bodies of water and provide for making them accessible to the general public by improved highways, leading to and driveways within such tracts.

Sec. 4. The tracts of land acquired for the state by the Department shall be kept in their natural state of beauty and only necessary structures or structures expressly authorized by law shall be erected therein. State parks and preserves shall not be operated for pecuniary profit, nor concessions for the use of them, or any part of them, or of any buildings, be leased or rented to persons for the carrying on of any business.

Sec. 5. The department shall have all necessary power to secure the proper control and policing of the state parks and preserves and shall take all necessary measures for the preservation of state property. It shall appoint such custodians and park police as it may deem necessary, and shall make reasonable rules for the regulation of the use of such state parks by the public. Regulations and rules for the conduct of the general public may be posted in conspicuous places in the state parks.

Sec. 6. Whoever: (1) Wilfully destroys, injures or defaces a guide-post, sign, fence, enclosure or structure within a state park or preserve; or (2) Wilfully destroys, injures or removes a tree, shrub or plant or flower within a state park or preserve; or (3) Violates any reasonable regulation adopted by the department and published by posting in conspicuous places, is guilty of a misdemeanor and shall be punished by a fine of not less than five dollars and not more than one hundred dollars or by imprisonment for not more than three months or by both fine and imprisonment.

Sec. 7. That Sections 1, 2, 5, 6, 7, 8, 8½, 10 and 11 of "An Act in relation to the acquisition, control, maintenance, improvements and protection of state parks, and making an appropriation to carry into effect the provisions of this Act," approved June 10, 1911, in force July 1, 1911, as amended, are repealed.

Sec. 8. There is appropriated to the Department of Public Works and Buildings, the sum of five hundred thousand dollars ($500,000) for the biennium commencing July 1, 1921, two hundred and fifty thousand dollars ($250,000) for the first year, and two hundred and fifty thousand dollars ($250,000) for the second year, for the acquisition and improvement of tracts of land and the establishment thereon of parks, preserves and experiment stations, as provided in this Act, and improvement of tracts of land and the establishment thereon of parks, preserves and experiment stations, as provided in this Act.

Sec. 9. This appropriation is subject to the provisions of "An Act in relation to State finance," approved June 10, 1919, in force July 1, 1919.

INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE

The following table presents the number of industrial fellowships which have been founded in the institute from March to March of each year, 1911 to 1921; the number of industrial fellows (research chemists and engineers) who have been employed; and the total amounts of money contributed for their maintenance by the industrial fellowship donors (industrialists and associations of manufacturers).

The total amount of money contributed by industrial firms to the institute for the ten years ending March 1, 1921, was $1,534,273. During the ten years, the institute itself expended approximately $470,000 in taking care of overhead expenses—salaries of members of the permanent staff and office force, maintenance of the building, purchase of books and

the above sums, an amount of money now apparatus, etc.—in connection with the operation of the industrial fellowships. Besides this amount, the building and permanent equipment of the institute, represent an investment of about $350,000. In addition to running into several million dollars, has been spent by the industries in developing into large scale manufacture various processes worked out at the institute.

March to March	Number of Fellowships	Number of Fellows	Total Foundation Sums
1911–1912	11	24	$ 39,700
1912–1913	16	30	54,300
1913–1914	21	37	78,400
1914–1915	21	32	61,200
1915–1916	36	63	126,800
1916–1917	42	65	149,100
1917–1918	42	64	172,000
1918–1919	47	77	238,245
1919–1920	47	83	293,680
1920–1921	48	83	320,848

APPOINTMENTS COMMITTEE FOR RUSSIAN SCIENTIFIC AND LITERARY MEN

The following appeal has been issued from the International Research Council, Burlington House, London.

Many Russians, distinguished in various branches of learning, are at present scattered over European countries. Some of them are destitute, others are earning a precarious livelihood by work in which they have no opportunity of exercising their particular capabilities, while, at the same time, the world at large is losing the benefit of their knowledge and aptitude.

With the view of assisting our unfortunate colleagues we have formed ourselves into a committee, the object of which is to bring their names and qualifications to the notice of universities and other institutions which may be able to offer them suitable employment.

We feel that we may count upon your sympathy, and in the hope that you may be able to help, we are forwarding a list of names, at present known to us, of those who would gratefully accept positions where they could continue the work to which they have devoted their lives.

The committee will have its central office in London, but it is proposed that cooperation between different countries be secured, either by the formation of similar committees, or by the cooption of corresponding members.

The committee consists of Sir Arthur Schuster, F.R.S., foreign secretary, Royal Society (Chairman); Viscount Bryce, F.R.S.; Sir Richard Gregory, editor of *Nature;* Sir Frederick Kenyon, president of the British Academy; Charles Scott Sherrington, president of the Royal Society; Ernest H. Starling, F.R.S., professor of physiology, University of London; Sir Paul Vinogradoff, F.B.A., professor of jurisprudence, University of Oxford, and Charles J. Martin, F.R.S., director, Lister Institute, London (Hon. Secretary).

THE VISIT OF MADAME CURIE

The following chemical societies have appointed committees to make arrangements for the reception of Madame Curie next May:

The American Chemical Society: Edgar F. Smith, chairman, L. H. Baekeland, Marston T. Bogert, Wilder D. Bancroft, Chas. F. Chandler, Chas. H. Herty, S. C. Lind, W. H. Nichols, Chas. L. Parsons, W. A. Noyes, Ira Remsen, T. W. Richards, J. E. Zanetti, B. B. Boltwood.

The American Electrochemical Society: W. S. Landis, chairman, H. B. Coho, Colin G. Fink, E. P. Mathewson, J. W. Richards.

The Société de Chimie Industrielle, American Section: George F. Kunz, chairman, L. H. Baekeland, M. T. Bogert, C. A. Doremus, J. E. Zanetti.

The Society of Chemical Industry, American Section: S. R. Church, chairman, H. G. Carrell, Chas. H. Herty, R. H. McKee, Allen Rogers.

The Chemists' Club of New York City: J. E. Zanetti, chairman, Ellwood Hendrick, M. T. Bogert, J. E. Teeple, Reston Stevenson, S. A. Tucker.

As Madame Curie is expected to be but a very short time in New York City, and as it would be impossible for her to attend functions given by any of the individual societies, the above named committees have appointed an Executive Committee, consisting of Edgar F. Smith, chairman, W. S. Landis, vice-chairman, S. R. Church, George F. Kunz, J. E. Zanetti, secretary-treasurer, to arrange for an entertainment to be given by all of the above named societies.

The committee has decided to give a luncheon in honor of Madame Curie at the Hotel Waldorf Astoria on Tuesday, May 17, and invitations have been sent to all the members of these societies living in and around New York. The headquarters of the committee are at The Chemists' Club, 52 East 41st Street, New York.

President Harding has through Mr. Arthur Brisbane subscribed fifty dollars to the Madame Curie Radium Fund. He writes: "I am so anxious about the success of the program to present to this distinguished woman a gram of radium that I would like to have a small part toward making the necessary provision."

LECTURES BY PROFESSOR EINSTEIN

Although Professor Einstein came to the United States primarily in the interests of the Zionist movement, he is giving scientific lectures at various universities. On April 15, he lectured in German on the theory of relativity at Columbia University, under the auspices of the departments of mathematics, physics, astronomy and philosophy, being introduced by Professor Pupin. Professor Einstein was awarded the Barnard medal by Columbia University last year on the recommendation of the National Academy of Sciences.

On April 18, 19, 20 and 21, Professor Einstein gave four lectures before the College of the City of New York on the following subjects: "The 'special' relativity theory;" "Generalized relativity and gravitation;" "The physical significance of entropy and quanta;" "Light-ether and radiation."

Princeton University has arranged five lectures on the theory of relativity on the afternoons from May 9 to 13, the subject of these lectures, which will be delivered in German, are first and second "Generalities on the theory of relativity," (without going deeply into the mathematical symbolism); third "Special theory of relativity," fourth "General theory of relativity and gravitation," fifth "Cosmological speculations." Scientific men are invited to the lectures. Admission will be by ticket, application for which should be forwarded to Professor H. D. Thompson, Princeton, N. J.

SCIENTIFIC NOTES AND NEWS

The American Philosophical Society is meeting in Philadelphia on Thursday, Friday and Saturday of the present week. The evening address is by Professor James H. Breasted, of the University of Chicago. The National Academy of Sciences meets at Washington on Monday, Tuesday and Wednesday of next week. The Prince of Monaco will make an address in the U. S. National Museum on Monday evening.

Dr. F. B. Jewett, chief engineer of the Western Electric Company and formerly professor of physics and engineering at the Massachusetts Institute of Technology, has been elected a vice-president and director of the company. He will continue his present work in charge of the technical forces of the telephone manufacturing industry.

Dr. Warner Jackson Morse has been appointed director of the Maine Agricultural Experiment Station. Since 1906 he has been connected with the Experiment Station, serving as plant pathologist since 1909. Dr. Morse succeeds Charles D. Woods, the circumstances of whose relations to the trustees have been stated in Science.

The governor of Massachusetts has recommended to the executive council Dr. Richard P. Strong, who holds the chair of tropical medicine at the Harvard Medical School, as a member of the Public Health Council, Boston.

Dr. William E. Musgrave has resigned as director of the University of California Medical School to accept the secretaryship of the state medical society and will edit the *California State Journal of Medicine*. Dr. Musgrave will continue his directorship of the Children's Hospital.

Dr. J. T. Willard, dean of general science and vice-president of the Kansas State Agricultural College, has been elected president of the Kansas Research Council. Dr. W. A.

Lippincott, professor of animal husbandry at the college, has been elected secretary.

Dr. George H. Shull, of Princeton University, has been appointed delegate of the American Philosophical Society to the second International Congress of Eugenics, which will be held in New York City in September.

At its last meeting the Rumford Committee of the American Academy of Arts and Sciences voted an appropriation of $200 to Professor Alpheus W. Smith, of the Ohio State University, in aid of his research on the Hall, Nernst and allied effects.

The prize of 25,000 marks, established two years ago by the late Berlin bacteriologist, Professor Hans Aronson, has been awarded to Professor von Wassermann, for his investigations on the Wassermann reaction.

Dr. F. H. Hatch has been appointed technical adviser to the British Mines Department on questions relating to the metalliferous mining industry.

We learn from *Nature* that at the anniversary meeting of the Royal Irish Academy on March 16 Professor Sydney Young was elected president in succession to the Reverend Dr. Bernard, provost of Trinity College, Dublin. Professor C. S. Sherrington, president of the Royal Society, was declared an honorary member in the section of science under the statute by which presidents of the Royal Society are honorary members of the academy.

At the annual general meeting of the Ray Society on March 10 the following officers were reelected: *President:* Professor W. C. McIntosh. *Treasurer:* Sir Sidney F. Harmer. *Secretary:* Dr. W. T. Calman. The Right Hon. Lord Rothschild was elected a vice-president, and Mr. E. E. Green, Mr. Chas. Oldham, and Sir David Prain were elected new members of the council.

Dr. and Mrs. N. L. Britton, of the New York Botanical Garden, accompanied by Dr. F. J. Seaver, have gone to Trinidad, in order to continue the botanical exploration of that island. They expect to return about the first of May.

Professor F. L. Stevens, of the University of Illinois, will go to Honolulu about the first of May to spend several months studying and collecting Hawaiian fungi, and arranging the mycological collection of the Bishop Museum.

J. W. Gidley, assistant curator of vertebrate paleontology at the National Museum, has gone for a two-month exploration trip in Arizona, California and Nebraska, for the United States Geological Survey and to secure fossil mammals for the museum collection.

"A lake as a going concern" was the subject of an address by President E. A. Birge, of the University of Wisconsin at the annual dinner of the Wisconsin Academy of Science, Arts and Letters, held at the University Club, Madison, on April 16. Dr. Birge is the retiring president of the academy.

Dr. Ludwik Silberstein, Research Laboratory, Eastman Kodak Company, will give a major course in physics at the University of Chicago during the summer quarter, 1921. It will deal with the theory of relativity, gravitation and electro-magnetism.

Dr. Albert H. Ebeling, of the Rockefeller Institute for Medical Research, lectured at Mount Holyoke College on April 8, on "Cultivation of tissues in vitro, with lantern slide demonstration."

A lecture was delivered April 11, 1921, before the Rochester Historical Society on the subject "Explorations in China" by Frederick G. Clapp. The same speaker addressed the Rochester Engineering Society at lunch on that day, the subject being "Engineering in China." Both talks were illustrated by lantern slides.

The following special lectures are being given at 5 p.m. in the main lecture hall of Cornell University Medical College, New York City.

April 11. "The influence of the rate of growth on structural efficiency," Professor Charles R. Stockard.

April 19. "An informal talk," Professor F. Gowland Hopkins.

May 5. "Glimpses backward into the history of metabolism," Professor Graham Lusk.

May 9. "The urinary sugar secretion," Professor S. G. Benedict.

The Dean and Chapter of Westminster Abbey have decided to place a bronze medallion in the Abbey as a memorial of Sir William Ramsay.

We learn from the *Journal* of the American Medical Association that at a recent meeting of some of Sir William Osler's students, an Osler Memorial Association was formed for the purpose of founding an Osler memorial lectureship at the University of California, which will provide for an annual lecture on a scientific subject. The expense will be met by a yearly assessment of the members of the association. Dr. George H. Whipple, president of the California Academy of Medicine, has advised that the academy will be glad to cooperate in securing lecturers and in sharing the expense. Dr. John M. T. Finney, Baltimore, has accepted an invitation to deliver the first lecture.

On February 24, the Berlin Ophthalmological Society held a special session in honor of the semicentennial of Albrecht von Graefe's death. The only living former assistant of Graefe, the ophthalmologist Professor Julius Hirshberg, now seventy-eight years of age, delivered the memorial address.

Dr. Henry Platt Cushing, for thirty years professor of geology in Western Reserve University, Cleveland, and for about the same time geologist in the Adirondack region for the Geological Survey of New York, died on April 14.

The late Harold C. Lloyd, a British subject residing in São Paulo, has bequeathed all his property in São Paulo to the Instituto Oswaldo Cruz, of which Professor Carlos Chagas is director, at Manguinhos, near Rio de Janeiro. The bequest is to be applied exclusively to promote research on prevention and treatment of infectious diseases.

The appropriation by Congress to the Forest Products Laboratory, at Madison, Wis., has been increased by approximately $100,000.

By the will of the late Dr. Alexander Muirhead, F.R.S., who was associated with Sir Oliver Lodge in work on wireless telegraphy, and who died on December 13, aged seventy-two, the Royal Society of London receives the sum of £3,000.

With the aid of a gift from Dr. Adolph Barkan, emeritus professor of the Stanford Medical School, the university is gathering in the Lane Library of the medical school in San Francisco a collection on the history of medicine. Dr. Barkan will give $1,000 a year for the next three years, to which the university will be able to add from the income from certain Lane Library Foundations $1,500 a year, making a total fund of $7,500, all of which will be expended on books concerning the history of medicine. Dr. Barkan is now in Europe and he has employed an expert to aid him in getting together this collection. Dr. Barkan was professor of structure and diseases of the eye, ear and larynx in the medical school and retired from active teaching in 1911. He has before this been a liberal benefactor of the Medical School Library, having given his own library dealing with the subjects in his own special field, together with $10,000 as a fund for the purchase of other books on these subjects.

The thirty-second session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences, which is located at Cold Spring Harbor, Long Island, New York, will be held next summer. The regular course work extends from July 6 to August 16. Courses are given in field zoology by Drs. H. E. Walter, of Brown University; S. I. Kornhauser, of Denison University, and H. M. Parshley, of Smith College; in comparative anatomy by Professor H. S. Pratt, of Haverford College; in principles of genetics by Professor H. S. Fish, of the University of Pittsburgh; in systematic and field botany by Dr. O. E. Jennings, of the University of Pittsburgh, and Mr. C. A.

Stiteler; in advanced botany by Dr. J. W. Harshberger, University of Pennsylvania. Opportunities for research are freely open to independent investigators. For the announcement address the Biological Laboratory at Cold Spring Harbor, N. Y.

The twelfth annual meeting of The American Oil Chemists' Society, formerly The Society of Cotton Products Analysts, will be held on May 16 and 17, the two days immediately preceding the twenty-fifth Annual Convention of the Inter-State Cottonseed Crushers' Association, at the Congress Hotel, Chicago. Besides the several committee reports addresses will be presented. In order to conserve time for discussion, it is planned to have abstracts of all committee reports in the hands of the members at the meeting, and to request that the discussion of these abstracts be prepared in writing in as many cases as possible. The annual banquet will be held Tuesday evening. The local committee has arranged a number of trips about the city to points of general interest to visitors and of special interest to chemists.

Under the auspices of the Wild Flower Preservation Society of America in cooperation with Community Center Department of the Public Schools the following lectures have been given in Washington:

February 9. The lure of Rock Creek Park: Dr. F. Lamson-Scribner.

February 16 and 23. Seeds, fruits and seedlings, Professor F. H. Hillman.

March 2. Roots and underground stems: Albert A. Hansen.

March 9. Stems, buds and their winter study: Dr. A. S. Hitchcock.

March 16. Leaf shapes, modifications and functions: Dr. Paul Bartsch.

March 23. Flowers and their functions: P. L. Ricker.

March 30. Where wild flowers grow and why: Dr. Edgar T. Wherry.

Free public lectures were delivered in the Central Display Greenhouse of the New York Botanical Garden on Sunday afternoons during April at 3:15 o'clock, as follows:

April 3. Fiber plants: Dr. A. B. Stout.

April 10. Milk-trees and other lactiferous plants: Dr. W. A. Murrill.

April 17. Air plants: Dr. H. A. Gleason.

April 24. Desert plants: Mr. G. V. Nash.

The fifteenth French Congress of Medicine will be held in Strasbourg from October 3 to 5, under the chairmanship of Dr. Bard, professor of clinical medicine in the University of Strasbourg. These are the subjects to be discussed: (1) the anatomic and functional adaptation of the heart to pathologic conditions of the circulation; papers by Dr. Cottin, of Strasbourg, and Dr. Demeyer, of Brussels; (2) glycemia; papers by Professor Ambard, Strasbourg; Dr. Chabanier, Paris, and Dr. Baudoin, Paris; and (3) antianaphylaxis; papers by Professor Widal, Paris; Drs. Abrami and Pasteur-Vallery-Radot, Paris, and Dr. Péhu, Lyons.

Chemical Abstracts has in process of printing a Formula Index to the 1920 volume. The indexing of chemical compounds by formulas, which is done in addition to the indexing by names, is a new departure for a chemical abstract journal. This index will contain about seven thousand entries.

The interchange of publications between Germany and the United States, which was suspended when this country entered the World War in 1917, has been resumed by the International Exchange Service of the Smithsonian Institution.

A scientific expedition to Spitzbergen is being organized by Oxford University, with the necessity of procuring £3,000 to carry out the work.

A new launch for use at the Macbride Lakeside Laboratory of the University of Iowa on Lake Okoboji, has been provided by a gift from Mr. Felix Hirschel, of Davenport.

During the Boston meeting of the American Medical Association in June there will be in the room used for exhibits on the floor of the special libraries at the Boston Public Library, an exhibit of early texts (Hippocrates to Sydenham) dealing with fevers and with specific infections. These will be arranged in

chronological order. In addition to the texts, there will be considerable illustrative material touching on hospitalization and treatment, the use of baths, venesection, new remedies, pest banners, broadsides and medals, also Saint Roch and Saint Sebastian, and various aspects of the plague and syphilis dealt with in the graphic arts. General texts illustrating the Greek, Byzantine, Mohammedan and medieval practise in fevers will occupy half of the space allotted. The other half will contain tracts on the plague and syphilis, original descriptions, new diseases and primary treatises on the doctrine of contagium vivum. A descriptive catalogue will be ready for distribution at the time of the annual session.

The London County Council according to the *British Medical Journal* has adopted the recommendations of the committee appointed by the Illuminating Engineering Society to inquire into eyestrain in cinematograph halls. These recommendations will be put into force at once so far as new halls are concerned, and will be applied to existing halls as opportunity offers. The chief recommendation sets out the limit of the vertical angle of view. The committee believes that ocular discomfort arises mainly from the abnormal angle at which very often the eyes of spectators are directed upwards, and that conditions suitable for the eyes would be secured if a moderate value for the angle of elevation were adopted. It is therefore proposed that the angle of elevation subtended at the eye of any person seated in the front row by the length of the vertical line dropped from the center of the top edge of the picture to the horizontal plane passing through the observer's eye shall not exceed 35 degrees. In some of the London halls this condition is complied with, and in others it is approached, but in others again the angle in question exceeds 60 degrees.

Nature states that the members of Mr. L. H. Dudley Buxton's expedition have now returned from a stay of some weeks in the Island of Malta. The object of the expedition was to collect material for a study of the physical anthropology of this island. About 1,000 adults, men and women, were measured. The fine series of ancient bones which Professor Zammit excavated in the Hypogæum at Hal-Saflieni and elsewhere was collected together and measured. A long series of skeletal remains from a modern ossuary were also examined. A special visit, lasting for two days, was paid to Gozo by Mrs. Jenkinson and Miss Moss to work at the physical anthropology of that island. The expedition has collected an immense mass of valuable material, which will take some time to arrange and digest. As soon as this work is sufficiently far advanced Mr. Buxton hopes to submit a preliminary account of the results of the expedition to the Royal Anthropological Institute.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Edmund Cogswell Converse, who died on April 4 in Pasadena, California, Amherst College receives a bequest of about $250,000. Of this amount $200,000 will be used for the upkeep and development of the Converse library, for the building of which Mr. Converse donated $250,000 in 1916, the building to be a memorial to his brother, James B. Converse. The remaining $50,000 of the bequest will be used to establish an Edmund Cogswell Converse scholarship fund.

The *Journal* of the American Medical Association writes that "much disappointment is being expressed in university circles in Toronto at the failure of the Ontario government to take action during the present session of the legislature on the report of their own appointed special commissions which has been inquiring into the status of the universities of the province. As the University of Toronto expected $1,000,000 from the Rockefeller Foundation there will be for the present no available funds for further expansion as it will be doubtful if even this sum will be forthcoming owing to the failure of the government to come to the assistance of the university."

THE trustees of the estate of the late John W. Sterling, to whom the residue of the estate was left in the interest of Yale University, have established two additional Sterling professorships at Yale; one of these is to be assigned for the present to mathematics, one to physiological chemistry. Professor Ernest W. Brown, of the department of mathematics, has been assigned to one of these professorships, and Professor Lafayette B. Mendel, professor of physiological chemistry has been assigned to the other. Four Sterling professorships have now been established, the other two being the new professorship of education recently filled by the appointment of Frank E. Spaulding, formerly superintendent of public schools in Cleveland, Ohio, and the new professorship of chemistry recently filled by the appointment of Professor John Johnston, formerly secretary of the National Research Council. Each of these professorships has an endowment of about $225,000. After meeting the salary of the professor, "the university shall have the right to use any surplus income of these funds in advancing the work of the said professorship through the appointment of assistants, aid in publication, opportunity for study or investigation in New Haven or elsewhere, or in other ways."

PROFESSOR PAUL H. M.-P. Brinton, head of the department of chemistry at the University of Arizona, has accepted appointment as professor of analytical chemistry in the school of chemistry at the University of Minnesota.

PROFESSOR HALE HOUSTON, head of the department of civil engineering at Clemson College, S. C., has been elected associate professor of engineering at Washington and Lee University, the appointment being effective on September 1.

AT Stanford University associate professors have been promoted to be professors as follows: William A. Manning in applied mathematics; Leroy Abrams in botany; Jesse B. Sears in education; Thomas Addis in medicine. Assistant professors to be associate professors: Edwin W. Schultz and William L. Holman in bacteriology; William M. Proctor in education; Charles N. Cross in mechanical engineering; Frank W. Weymouth in physiology; John E. Coover in psychology. Assistant clinical professor to be assistant professor: Henry G. Mehrtens, in medicine. Instructors to be assistant professors: Elizabeth L. Buckingham, and Edith R. Mirrielees in English; Edward B. Towne in surgery; James P. Baumberger in physiology; Gordon F. Ferris in entomology (zoology).

PROFESSOR BRAUS, of Heidelberg, has been proposed as the successor to Professor O. Hertwig, of Berlin, who has sent in his resignation.

DISCUSSION AND CORRESPONDENCE

GENETICS OF THE "CHINCHILLA" RABBIT

A CONSIDERABLE interest exists in the raising of rabbits for fur, stimulated no doubt by the extensive use and high price of fur garments in recent years, and by the fact that wild fur-bearing animals are on the decrease. Rabbit fur has long been used as a substitute for other furs and sold misbranded but is coming to be used under its own name and on its own merits. One impetus to such use comes from the development chiefly in France of breeds whose fur is attractive in its natural colors. Among such breeds are the chocolate or "Havana," the French silver of "champagne d'argent," and the "Chinchilla." This last is an especially pleasing color variety of a pearl gray color. The coat is similar to that of a wild gray rabbit except that (1) it contains no yellow whatever, the yellow ticking of gray rabbit fur being replaced with white, and (2) the black portions of the gray fur are toned down to a slaty blue. Both these differences appear to follow from a single genetic change, a mutation in the color factor less extreme than that which has occurred in the white or albino variety, yet affecting the same genetic factor or "gene."

If a chinchilla rabbit is crossed with any of the common color varieties other than white, the chinchilla character behaves as a reces-

sive in heredity, in which it agrees with the behavior of the albino character. But if it is crossed with the albino variety itself, offspring are produced all of which are chinchillas, and in later generations both chinchilla and white young are to be expected. These facts indicate that it is an alternative form or allelomorph of albinism. It constitutes the fourth recorded albino allelomorph in rabbits, the series in the order of decreasing pigmentation being (1) ordinary pigmentation, (2) chinchilla, (3) Himalayan albinism, (4) ordinary albinism (snow white). A similar but not identical series of albino allelomorphs was described for the guinea pig several years ago by Sewall Wright.[1] Chinchilla seems to be substantially equivalent to the guinea-pig albino allelomorph seen in the red-eyed silver agouti variety. A homologous albino allelomorph in the rat has been described by Whiting and King,[2] under the name of ruby-eyed dilute gray.

One defect of the new fur varieties of rabbits is their relatively small size. Furriers desire larger, stronger pelts, such as can be obtained only from large-sized animals. In the case of the chinchilla variety the desired improvement can be obtained easily and speedily. The desired size is found in varieties raised chiefly for meat, such as the Flemish Giant. Various color varieties occur in this breed including the albino, known as "white Flemish." By mating a pure chinchilla with white Flemish rabbits, young will be obtained all of which will be chinchillas in color yet will have increased size, intermediate or a little greater than intermediate between the sizes of the respective parents. By further crossing of the improved chinchillas with white Flemish, still larger chinchillas may be obtained, and in a very short time the full size of the Flemish breed may be substantially secured in a rabbit having the chinchilla coat. In this process of improvement there will be no wasters, unless the fifty per cent. of whites are so regarded, for the peculiar method of inheritance renders all other young valuable, since all will be chinchillas.

W. E. Castle
Bussey Institution

1 Carnegie Institution of Washington, Publication No. 241, 1916.

2 *Jour. Exp. Zool.*, 26, 1918.

THE EARLY HISTORY OF LITMUS IN BACTERIOLOGY

The writer is indebted to Professor F. G. Novy, of the University of Michigan, for the correction of a statement in a recent article entitled "Chemical Criteria of Anaerobiosis with Special Reference to Methylene Blue," published in the *Journal of Bacteriology,* January, 1921, Volume 6, page 1.

The statement in question is as follows:

> "The earliest authentic reference to the bacteriological use of litmus appears to be that of Wurtz (1892) who introduced litmus lactose agar as a differential medium for *Bact. coli* and *Bact. typhosum.* It was impossible to confirm Novy's (1893) allusion (copied by Hunziker, 1902) to Buchner (1885) and Cohen (?) as first to use litmus acid and reduction changes respectively, the last reference apparently being altogether erroneous."

Professor Novy points out in a letter, which is quoted by permission, that many of the workers of that period, including himself, had used litmus for several years prior to the date of Wurtz's paper. As Professor Novy says, "Wurtz was a late comer." My reference to Wurtz as apparently the first can be defended only upon the admittedly uncertain grounds that having attempted in vain to find a reference to litmus in Buchner's article as quoted by Novy and Hunziker, and having failed to find even an article by Cohen, I took what seemed at the time the earliest authentic reference.

The following is quoted verbatim from Professor Novy's letter:

> It is true that the references are not correct; whether it be due to failure to send me proof, or to my own carelessness I am unable to say.
>
> The only reference which I give to Buchner is to E. Buchner, the chemist, and concerns his hydrogen culture work. My text (p. 597) mentioned Buchner (unqualified) and, as was more or less the custom of the day, it meant the bacteriologist, Hans Buchner. Unfortunately, through some slip no reference to his work is given.

Buchner was apparently the first to use litmus media for bacteria, although the ophthalmologist Leber preceded him by three years, employing litmus gelatine to demonstrate acid production by *Aspergillus*.

Cahen, and not "Cohen (?)," published his paper in the *Journal* given, in the next volume to that cited. While the citation is not correct as to volume and page, still with the name and *Journal* given it hardly justifies characterization as "apparently altogether erroneous."

It thus appears that both of us have been to some extent guilty and the present note is therefore offered in mutual condonation.

The following list of *authentic references* prior to 1890 was supplied by Professor Novy and each has been confirmed by the undersigned.

Leber—*Berl. klin. Wchnschr.*, 1882, 19. 163.
H. Buchner—*Arch. f. Hyg.*, 1885, 3, pp. 417, 418, 419.
Marpmann—*Centralbl. f. d. allgemeine Gesundheitspflege; Ergänzungshefte*, 1885–1886, 2, Heft 2, p. 123. (The number appeared in 1886 but the title page of the volume bears date of 1889.)
Weisser—*Ztschr. f. Hyg.*, 1886, 1, p. 334.
Cahen—*Ibid.*, 1887, 2, pp. 387, 394.
Neisser—*Virchow's Archiv. f. pathol. Anat. u. Physiol.*, 1887, 110, p. 394.
Loeffler—*Berl. klin. Wchnschr.*, 1887, 24, pp. 610, 631.
Berhring—*Ztschr. f. Hyg.*, 1889, 6, p. 142; 7, pp. 173, 177.
Petruschky—*Centralbl. f. Bakteriol.*, 1889, 6, pp. 628, 657.

Ivan C. Hall
University of California

ANOTHER DRIFT BOTTLE WHICH CROSSED THE ATLANTIC

In a previous note[1] the writer gave the record of a bottle which drifted from the Gulf of Maine to the Azores. Recently record has been received of a bottle which was picked up in the Orkney Islands. This bottle, No. 230, was set out on the same day (August 29, 1919) as No. 198 which went to the Azores and was put out about 6½ miles to the southeast of it, *i.e.*, 7½ miles southeast of Point Lepreaux in the Bay of Fundy. It was picked up on the Island of Papa Westray, one of the northwestern islands of the Orkney group, on January 21, 1921, about one year and five months after it was set out. This bottle probably followed the northern route of the North Atlantic wind drift ("Gulf Stream") as indicated for another bottle recorded previously.[1]

[1] "On a bottle which drifted from the Gulf of Maine to the Azores," Science, N. S., Vol. LIII., No. 1365, February 25, 1921. Through a misprint the writer's name was given as "James W. Moor" instead of "James W. Mavor."

James W. Mavor
Union College,
Schenectady, N. Y.

NEWSPAPER SCIENCE

To the Editor of Science: The recent press reports quoting me as saying that I had "obtained the closest approach to a perfect vacuum ever recorded" are false and without foundation. The daily press copied and added to an item in the *Utah Chronicle*, a student paper, which itself was inaccurate in saying I had "perfected the apparatus." The student reporter after seeing in the department of physics a well-known form of vacuum pump wrote the original article without submitting it to me before publication. I am taking this opportunity to deny the statements credited to me by the newspapers which have given me so much undesirable and distasteful publicity.

Orin Tugman
University of Utah,
April 8, 1921

SCIENTIFIC BOOKS

Atmospheric Pollution.[1] Sixth Report of the Committee for the Investigation of Atmospheric Pollution.

(In Science, November 28, 1919, a summary of the fourth report of this committee, on the work in 1917–18, is given.)

[1] Meteorological Office. Report on Observations for year ending March 31, 1920, London, 1921.

In all 29 gages are in operation—distributed as follows: Birmingham 3, London 8, Glasgow 9, Southport 2, and 1 each at Kingston, Malvern, Newcastle, Rochdale, Rothamsted, St. Helens, and Sterling. Two more stations are about to operate.

Full returns have been published in the *Lancet.*

The following data are given in this report:

1. Monthly deposits for the two stations representing high and low deposits.

2. Total solids deposited monthly at all stations.

3. Mean monthly deposits for summer half years, *i.e.,* April to September, 1918 and 1919.

4. Mean monthly deposits for winter half years, *i.e.,* October to March, 1918–19, and 1919–20.

5 and 6. Classification of stations according to amounts of elements.

7 and 8. Totals of classified stations for each element of pollution.

9. Comparison of mean monthly deposit during summer and winter.

10. Average deposit of each element for each month for two London and four Glasgow stations.

Also six summaries and analyses.

The station showing the highest mean monthly deposit for the year is Southwark Park, London, with 15.35 metric tons per square kilometer, but it is said that probably Newcastle or Rochdale, for which full year results were not available, might have exceeded this figure. The lowest value was 3.17 at Malvern.

The following table[2] gives the mean monthly deposits as selected stations:

MEAN MONTHLY DEPOSIT IN METRIC TONS PER SQUARE KILOMETER

Meteorological Office	8.43
Finsbury Park	10.78
Ravenscourt Park	14.09
Southwark Park	15.35
Hesketh Park	6.41
Woodvale Moss	5.34
Bellahouston Park	8.87
Botanic Gardens	10.91
Queens Park	8.01
Richmond Park	12.15

[2] Abridged. Full table gives quantities of tar, carbonaceous matter, etc.

Generally speaking there is evidence of a considerable diminution of summer deposit in practically all the districts.

The highest deposit of tar in the London group was in February, the lowest in May; while in the Glasgow group the highest was in November and the lowest in September. This may be regarded as a normal distribution, as the winter months, including the two highest deposits, are the time when domestic fires are in operation, while the lowest deposits occurring in May and September, are in the summer months when fires are presumably not required. In Glasgow there is a second minimum in December and February. Wind doubtless has a great influence on the quantity of deposit, high winds sweeping it away from the vicinity of its origin and calm weather favoring deposit near the source of impurity.

Of the research work, the chief problem has been accurate measurements of acidity in the air. Automatic filters have been devised, holding 24-hour discs and many records have been made of impurities in London air. It has been shown that there is a definite cycle in the distribution of the impurities during the 24 hours. From midnight to 6 A.M. the air is practically clean of impurity, very little being recorded except during fogs. At about 6 A.M., when fires are lit, there is an increase in impurity continuing until 11. From 11 to 10 P.M. the quantity varies very little. At 10 it begins to diminish rapidly and has almost disappeared by midnight.

The committee is considering the possibility of utilizing standard rain gages. For large deposits this might work, but for country places with small deposits the 20 cm. gage (8 inch diameter) would not suffice since the area of this gage is practically 1/10 that of the standard deposit gage. One great objection to the use of the standard rain gage is the impossibility of estimating the quantity of tar and

sulphates present; and these indicate the origin of the deposit.

To investigate this matter, however, the committee had the water collected in the 8-in. rain gage on the roof of the Meteorological Office analyzed for two or three months. During the month of November the small 8-in. gage collected 900 c.c. of water, the total deposit was 0.445 gramme, the total soluble 0.34 gramme, while in the standard deposit gage, the water collected was 783 liters, total deposit 1.962 grammes, total soluble 0.53 gramme. There was, therefore, a large excess of soluble matter in the water collected in the rain gage. The same result was found in subsequent months, and it was ascertained that the excess of soluble matter was due to metal dissolved from the rain gage.

It was therefore useless to continue the experiment unless the solution of the metal could be prevented. In order to do this the rain gage was given a coating of Duroprene varnish, in the hope that this would prevent the solution of the metal without any contamination of the water.

The result of the analysis of a month's rainfall showed for the 8-in. rain gage a considerably larger proportion of soluble and insoluble matter per liter of water as compared with the standard deposit gage, owing to the varnish yielding to the action of the rain water. It is therefore clear, if observations are to be taken with small gages these must be constructed of something which will not dissolve in the water, and the use of the ordinary copper rain gages is therefore inadmissible.

ALEXANDER MCADIE

SPECIAL ARTICLES

THE MECHANISM OF AN ENZYME REACTION AS EXEMPLIFIED BY PEPSIN DIGESTION[1]

ONE of the most striking peculiarities of living matter is the fact that nearly all the reactions which take place in the organism are due to enzymes. The mechanism of enzyme reactions is therefore very closely connected with the mechanism of the living cell. Many enzyme reactions, however, may be studied in vitro and are therefore amenable to quantitative study. The present paper is an attempt to show that the peculiarities of a typical enzyme reaction, pepsin digestion, may be explained by the accepted laws of chemical reactions and that the apparent divergencies from these laws are due to the fact that the enzyme as well as the protein with which it reacts exist in solution as equilibrium mixtures, consisting, in the case of the protein of ionized and non-ionized protein, and in the case of the pepsin of free and combined pepsin. The influence of the various factors on the digestion are primarily due to changes in these equilibria.

It is well known that enzyme reactions in general have certain peculiarities which distinguish them from ordinary chemical reactions. These may be briefly stated as follows:

1. The final amount of change caused by the enzyme is independent of the amount of enzyme present.

2. The rate of change may or may not be proportional to the concentration of enzyme present.

3. The rate of change is proportional to the substrate concentration in dilute solution but increases less rapidly than the substrate concentration in solution of higher concentration.

4. The amount of substrate decomposed in the same time interval by varying enzyme concentrations is not always proportional to the concentration of enzyme but is often proportional to the square root of this quantity (Schütz's rule).

5. The reaction proceeds most rapidly at a certain definite hydrogen ion concentration.

It has been found in a study of pepsin digestion that the above peculiarities may be quantitatively accounted for on the basis of the following mechanism.

1. The protein reacts with the acid of the

[1] The experimental data on which this paper is based may be found in *J. Gen. Physiol.*, 1918–19, I., 607; 1919–20, II., 113, 465, 471, 595; 1920–21, III., 211.

solution to form an ionized protein salt. The amount of this salt formed is determined by the hydrogen ion concentration of the solution according to the well-known laws governing the reaction of an acid and a weak base.

2. The pepsin is present in the solution, (*a*) as free, probably negatively charged pepsin, and (*b*) in combination with the products of hydrolysis of the protein. These two forms are in equilibrium with each other and their relative concentration depends on the amount of products of hydrolysis present in the solution as demanded by the law of mass action.

3. The reaction takes place between the ionized protein and the free pepsin.

EXPERIMENTAL EVIDENCE FOR THE ABOVE STATEMENTS

Loeb[2] has shown by direct experiment that the protein exists in solution in an equilibrium condition as stated under (1).

Rekelharing and Ringer[3] have shown that purified pepsin in solution is negatively charged. It may be shown by direct experiment that the addition of products of hydrolysis decrease the activity of the enzyme and that the amount of the decrease in the activity can be predicted by the law of mass action.

The validity of the third assumption may best be tested by applying the proposed mechanism to the explanation of the characteristic peculiarities of the reaction outlined under (1 to 5).

1. *Influence of Quantity of Enzyme on the Final Equilibrium.*—Since the free enzyme and the products of hydrolysis are in equilibrium there will always be some active (free) enzyme present no matter how high the concentration of products becomes. The reaction will therefore proceed to approximately the same point irrespective of the amount of enzyme present at the beginning of the reaction. It will be seen, however, that the final equilibrium will depend to a slight extent on the amount of enzyme present since some of the products of hydrolysis are combined with the enzyme.

2. *Concentration of Enzyme.*—If the enzyme solution is pure, the rate of hydrolysis, other factors being constant, will be directly proportional to the concentration of enzyme taken. If the enzyme solution contains products of hydrolysis or other substances with which the enzyme is combined then the rate of hydrolysis will increase more slowly than the concentration of enzyme solution since the amount of free enzyme present becomes relatively smaller the higher the concentration.

3. *Concentration of Protein.*—If the rate of hydrolysis of the protein is proportional to the concentration of *ionized* protein then the rate must increase more slowly than the total protein concentration since the ionization of the protein salt is less in concentrated than in dilute solution.

4. *Schütz's Rule.*—Arrhenius[4] has pointed out that in an equilibrium system, such as exists between free pepsin and the products of hydrolysis, the concentration of one of the reacting molecules or ions becomes inversely proportional to the concentration of the second as soon as the second is present in large excess. That is, the amount of free pepsin present, after the first few minutes of the reaction, is inversely proportional to the amount of products formed. It follows from this that the amount of hydrolysis at any time is proportional to the square root of the time elapsed, which is one form of Schütz's rule.

5. *The Influence of the Hydrogen Ion Concentration.*—It is clear that the more acid is added to the protein the more protein salt will be formed until all the protein is present in the form of protein-acid salt. This salt is practically completely ionized in dilute solution as may be shown by direct measurement

[2] Loeb, J., *J. Gen. Physiol.*, 1918–19, I.; 1919–20, II.

[3] Peckelharing, C. A., and Ringer, W. E., *Z. physiol. Chem.*, 1911, LXXV., 282.

[4] Arrhenius, S., "Quantitative Laws in Biological Chemistry," London, 1915, pp. 36–48.

of the anion concentration by means of concentration cells. A further increase in the amount of acid will now serve to decrease the concentration of protein ions by increasing the concentration of the common anion. The concentration of ionized protein will therefore pass through a maximum which should coincide with the maximum for the rate of digestion. If the ordinary theory of chemical kinetics, on the basis of the law of mass action, be applied to the above system, it may be predicted that:

I. The optimum hydrogen ion concentration for the digestion of the protein must coincide with the hydrogen ion concentration at which the concentration of protein ions and therefore the conductivity due to the protein is at a maximum.

II. The limiting pH for the activity of pepsin on the alkaline side must depend on the isoelectric point of the protein, since this is the point at which the protein first begins to react with the acid.

III. The addition of a salt with the same anion as the acid to a solution already containing the optimum amount of acid will have the same depressing effect on the digestion as the addition of the same amount of anion in the form of acid.

IV. The pepsin should combine with the protein only when the latter is ionized, *i.e.*, pepsin should behave the same as the inorganic anions studied by Loeb.

These predictions have been tested quantitatively and found to be fulfilled. It has also been found by direct experiment that neither the influence of the acidity on the destruction of the enzyme, nor the viscosity of the protein solution can account for the influence of the hydrogen ion concentration on the rate of digestion.

It will be seen that from this point of view pepsin digestion is a chemical reaction in which the pepsin as well as the protein takes part. It is therefore not a catalytic reaction at all in the classical sense. The specificity of the reaction is therefore probably governed by the same conditions that determine the specificity of any chemical reaction, since from a quantitative standpoint each chemical reaction is specific. It may be added that a very similar mechanism was proposed by Stieglitz and his collaborators for the hydrolysis of the imido esters by acid.

It is, of course, impossible at present to apply these results directly to the activities of the living organism since conditions there are much more complex. It is probable, however, that much of the apparent complexity is due to the fact that several processes, each simple in itself, occur simultaneously and thus lead to a complicated result. Dernby's[5] experiments render it probable that the phenomenon of autolysis may be explained in this way.

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KNIPP'S SINGING TUBE

MY colleague, Dr. C. T. Knipp, when constructing a piece of apparatus, found that one of the parts—a glass tube intended for a mercury trap—gave forth a musical sound under the heating action of a gas flame. Following this clue he constructed various modifications of the tube and described them with the interesting results obtained.[1] Inquiry has been expressed concerning the explanation of its action. It occurred to the writer that this explanation might be found in the theory advanced for similar cases where sounds are maintained by heat.[2]

Fig. 1 pictures one type of the tubes tested. It is a resonator with a loop at A and a node at N, so that the distance $ABCN$ constitutes approximately one fourth of the wave-length of the sound given out by the tube when operating.[3] The air surges back and forth at A with the greatest velocity and displacement. From this point the to and fro motion of the

[5] Dernby, K. G., *Biochem. Z.*, 1917, LXXXI., 198.

[1] *Phys. Rev.*, Vol. 15, p. 155, 1920; and other publications.

[2] Rayleigh, "Theory of Sound," Sec. 322. Barton, "Text-Book of Sound," Sec. 265–277.

[3] *Phys. Rev.*, Vol. 15, p. 336, 1920.

air grows gradually less until it becomes zero at the node N. Compressions and rarefactions have maximum values at N and grow less in intensity until at A there is no change in pressure. The oscillating motion will persist for a number of vibrations until the friction with the sides of the tube gradually brings about a condition of rest. If the motion is to be maintained, energy must be supplied to the vibrating system. In Dr. Knipp's apparatus, this energy is furnished at cc by a ring burner gas flame.

As the air surges up the tube and turns to pass into D, it is brought into intimate contact with hot glass at CC. This portion of heated air communicates its energy to surrounding air particles at D and results in a general rise of temperature in this region. It tends to expand the air. Just at this time, the air begins to surge in the opposite direction throughout the tube and the tendency to expand at D assists this return surge.

When the air surges back from D to EE it becomes heated again at C and the heat acquired is given up partly to the glass at EE, thus causing a cooling and consequently contraction. In the meantime, the air has finished its outward motion and is ready to

Fig. 1.

surge back toward the inner part of the tube. The cooled air at EE by its contraction assists this motion. Thus, the motion is maintained first by the heating effect (expansion) at D and half a period later by the cooling effect (contraction) at EE.

The alternating motions are quite rapid since the vibrations in the various types of tubes range from 30 to 250 times per second. It is well established that air may be heated and cooled thus rapidly because the accepted explanation for the propagation of sound in air requires this rapid change in temperature.

The amplitude of the motion at CC is not great but appears to have a range from 0.5 to 1.5 cm., depending on the tube used. The lower pitched tubes have the larger amplitude. The area of glass heated is small so that the temperature gradient from the red hot glass to the cooler portion 0.5 cm. distant may be several hundred degrees, thus allowing a confirmation of the theory advanced.

The additions and subtractions of heat to the air are not impulsive but, by the processes of transmission explained, gradually build up to maxima at suitable instants to maintain the motion. Cooling the tube at BE assists the vibration. The motion is maintained more easily if the area of the annual ring at BEC is made smaller than the area of the tube at D. This results in a greater amplitude of motion at C in agreement with the theory.

Mechanically, the motion may be likened to the motion of a system consisting of a spring that is fastened at one end with a weight at the other end that vibrates back and forth. (See Fig. 2.) When the mass m moves to the

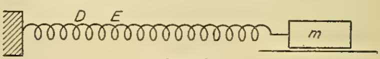

Fig. 2.

left, the spring is compressed and presently when equilibrium is reached, the motion reverses. If, at this instant, the spring at D could be strengthened by the insertion of several coils, the return motion would be assisted. This corresponds to the addition of heat in Dr. Knipp's tube.

When the spring has expanded to the other limit of its vibration, imagine several loops

of the spring at *EE* removed so that the tension, or pulling together of the spring, is strengthened. There is a consequent additional pull on the mass just when it is needed to encourage the motion. This effect corresponds to the cooling of the air in the singing tube at *EE*.

F. R. WATSON

LABORATORY OF PHYSICS,
UNIVERSITY OF ILLINOIS

THE AMERICAN PHYSIOLOGICAL SOCIETY

THE American Physiological Society held a very successful meeting at the University of Chicago during convocation week. The scientific program covered three days of December 28, 29 and 30 with two daily sessions each. The evenings were given to general meetings and social intercourse. On the evening of December 28 the Physiologists joined with the other Biological Societies in the annual dinner of the Federation of American Societies for Experimental Biology.

The dinner is looked forward to by the membership as the annual social event of the meetings. Dr. Roswell H. Park, president of the American Society for Experimental Pathology and chairman of the executive committee for the year 1920 presided at the dinner. Addresses were made by Dr. Simon Flexner, of the Rockefeller Institute for Experimental Biology and Medicine, and Dr. William H. Howell, of the School of Hygiene and Public Health of the Johns Hopkins University. A less formal dinner was also held on the evening of December 29.

The chief events of the two business meetings of the Physiological Society were the following:

1. Announcement of the forthcoming introductory number of the new journal issued under the auspices of the society, *Physiological Reviews*, which appeared early in the new year.

2. The annual dues for 1921 were fixed at $2 by the council.

3. The council announced the appointment of Donald R. Hooker as managing editor for the *American Journal of Physiology* for 1921.

4. The council announced the appointment of Donald R. Hooker as managing editor, and Wm. H. Howell, J. J. R. Macleod, Frederic S. Lee, D. R. Hooker, L. B. Mendel, Reid Hunt and Gideon H. Wells as the editorial board for *Physiological Reviews* for the year 1921.

5. Reports of the treasurer were received and audited.

6. The officers elected for the ensuing year are:

President, J. J. R. Macleod, University of Toronto.

Secretary, Chas. W. Greene, University of Missouri.

Treasurer, Joseph Erlanger, Washington University, St. Louis.

Councilman for the term, 1921–1924, A. J. Carlson, University of Chicago.

Councilman for the unexpired term of President-elect Macleod, J. A. E. Eyster, University of Wisconsin.

7. The following new members were nominated by the council and elected by the society:

J. B. Collip, A.M., Ph.D., assistant professor in physiology and biochemistry, University of Alberta.

W. Dennis, A.M., Ph.D., assistant professor of physiological chemistry, Tulane University.

L. R. Dragstedt, Ph.D., assistant professor of physiology, University of Chicago.

F. S. Hammett, A.B., M.S., Ph.D., fellow in biochemistry at the Wistar Institute.

Fraser Harris, M.D., D.Sc., professor of physiology and histology, Dalhousie University, Halifax, N. S.

Selig Hecht, Ph.D., assistant professor of physiology, Creighton Medical College, Omaha.

Davenport Hooker, B.A., M.A., Ph.D., professor of anatomy, University of Pittsburgh, School of Medicine.

Norman M. Keith, instructor in medicine, Mayo Clinic, Rochester, Minn.

S. O. Mast, B.S., Ph.D., professor of zoology, Johns Hopkins University.

Jas. M. D. Olmsted, M.A., Ph.D., assistant professor in physiology, Toronto University.

Thos. L. Patterson, A.B., A.M., M.S., Ph.D., assistant professor of physiology, University of Iowa.

Maurice I. Smith, B.S., M.D., pharmacologist, U. S. Public Health Service, Washington, D. C.

8. A new fellowship for Research in Physiology was established under the control of the society by the generous contribution of William T. Porter, of the Harvard Medical School. Dr. Porter contributed $1,200 as an annual stipend to establish a fellowship for research in physiology under the auspices of the American Physiological Society and the administration of its council. The acceptance of the proposition was recommended by the council and accepted with appreciation by vote of the society. The fellowship will begin October 1, 1921, and is to be filled by nomination by members of

the Physiological Society and appointment by the council.

A noteworthy event of the meeting was an exhibit of old and historical books on anatomy and physiology arranged by Professor Arno B. Luckhardt, of the University of Chicago. This exhibit was open during the entire session. A very profitable scientific program was carried forward as recorded below. The society in closing its annual session passed the following resolution:

Resolved: That the American Physiological Society expresses its keen appreciation to the authorities of the University of Chicago and to the local committee for the numerous and effective arrangements that have contributed in a large degree to the scientific and social success of this the thirty-third annual session of the society.

SCIENTIFIC PROGRAM

The scientific program of research titles is recorded herewith in full:

In memoriam Samuel James Meltzer: Wm. H. Howell, Baltimore, and Simon Flexner, New York.

The volume changes in the cerebrospinal fluid under the influence of drugs: F. C. Becht, Northwestern University Medical School.

Use of hypertonic salt in experimental intracranial pressure: Ernest Sachs and J. Y. Malone (by invitation), Washington University.

Forms of infections and communicable encephalitis in man and animals: Simon Flexner.

A physiochemical method of characterizing proteins. II.: Edwin J. Cohn.

A separation of substances eliminated by the kidney into groups on the basis of the effects of changes in blood flow and temporary anœmia: E. K. Marshall, Jr., and Marian M. Crane (by invitation), Washington University Medical School, St. Louis.

The synthesis and elimination of hippuric acid in nephritis: F. B. Kingsbury and W. W. Swanson (by invitation).

A crystalline uric acid compound in beef blood: Alice Rohde Davis and Stanley R. Benedict.

Further observations on the mechanism of the keto-lytic (anti-ketogenic) action of glucose. (a) *In vitro experiments.* (b) *Data from respiration experiments on man:* P. A. Shaffer.

The lipoid balance in the blood: W. R. Bloor.

The nature of blood clotting, as viewed from the action of tissue extracts: C. A. Mills (by invitation) and G. M. Guest (by invitation).

The inhibitory influence of the cervical sympathetic nerve upon the sphincter muscle of the iris: Don R. Joseph, St. Louis University.

Consistency of protoplasm and character of amœboid movement: Leo Loeb, Washington University, St. Louis.

The internal secretion of Sandstrom's glands, parathyroid hypofunction and eclampsia: Aldo C. Massaglia (by invitation), Northwestern University Medical School.

Thyro-parathyroidectomy in the sheep: Sutherland Simpson, Cornell University.

Technique and general effects of removal of the liver: F. C. Mann, Mayo Foundation, Rochester, Minn.

The liver as a regulator of the glucose concentration of the blood and nitrogen constituents of the blood following its removal: F. C. Mann and T. B. Magath (by invitation), Mayo Foundation.

Production of ammonia in the nerve during excitation: Shiro Tashiro, University of Cincinnati.

Further experiments on the removal of the sino-auricular node: J. A. E. Eyster and W. J. Meek.

Vagal apnoea: W. J. Meek.

Heat-block in nerves: Percy M. Dawson and Elvia Ostlund (by invitation), University of Wisconsin.

Studies on the physiological effects of X-rays: (1) *On the variation in the lethal dose during metamorphoses in the fruit-fly, Drosophila:* James W. Mavor (by invitation), Union College, New York.

Readjustment of the peripheral lung motor mechanism after bilateral vagotomy: T. L. Patterson (by invitation), University of Iowa.

A study of denervated tissues: F. A. Hartman and W. E. Blatz (by invitation), University of Buffalo.

Changes in temperature and pulse rate in the rabbit during innoculations of fever: F. M. Baldwin and E. N. Miller (by invitation), Iowa State College.

The changes in the H-ion concentration coincident with the growth of bacterium tumefaciens and other plant pathogens: Wm. H. Chambers (by invitation), Washington University, St. Louis, Mo.

Difference in the H-ion concentration of the sensible, regional and total perspiration of the body: George A. Talbert, Fairmount College, Wichita, Kansas.

Plasma sodium chloride and œdema in diabetes: Russell M. Wilder (by invitation) and Carol Beeler (by invitation), Mayo Foundation, Rochester.

Respiratory changes occurring during exercise: Roy J. Pearce, Akron, Ohio.

Further observations on the movement of the arterial walls under pneumatic compression: Joseph Erlanger, Washington University, St. Louis.

Oxygen consumption during repeated slight hemorrhages: H. Schlomowitz, Ethyl Ronzoni (by invitation), and H. H. Schlomowitz (by invitation), Marquette Medical School, Milwaukee, Wisconsin.

Effect of hemorrhage on the response to oxygen reduction: Robert Gesell, Edward Blair (by invitation), and Robert Trotter (by invitation), University of California.

The rate of methemoglobin formation of carboxyhemoglobin: T. K. Kruse, University of Pittsburgh.

Error as a criterion of industrial fatigue: E. G. Martin and J. P. Baumberger (by invitation), Stanford University.

Salt antagonisms in artemia: E. G. Martin and Blake C. Wilbur (by invitation), Stanford University.

Hours of work in relation to the quantity of the output: A. H. Ryan and P. S. Florence (by invitation), Tufts Medical College, Boston.

The response of a muscle to submaxial stimulation of its motor nerve as affected by reflex excitation and inhibition: Alexander Forbes, Harvard Medical School.

On a volatile sperm-stimulating substance derived, from marine eggs: G. H. A. Clowes.

Some effects of increased and decreased oxygen pressure on embryos of ring-doves: Oscar Riddle, Cold Spring Harbor, Long Island.

The fat soluble vitamine: H. Steenbock, Mariana T. Sell (by invitation), and E. M. Nelson (by invitation).

Further observations on the epinephrin output of the adrenals: G. N. Stewart and J. M. Rogoff, Western Reserve University.

The effect of adrenalectomy upon the total metabolism of the cat: Joseph C. Aub, J. Forman (by invitation), and E. M. Bright (by invitation), Harvard Medical School.

The relationship of the increase in blood sugar concentration to (a) *The specific dynamic action of glucose and to* (b) *The specific dynamic action of adrenalin:* W. M. Boothby and Irene Sandiford (by invitation), Mayo Foundation, Rochester, Minn.

Nomographic charts for the calculation of the basal metabolic rate: W. M. Boothby and R. B. Sandiford (by invitation), Mayo Foundation, Rochester, Minn.

Specific dynamic action of thyroxin: H. S. Plummer (by invitation), and W. M. Boothby.

Vasomotor reactions of the nasal cavity and postnasal space to chilling of the body surface: Stuart Mudd (by invitation), Samuel B. Grant (by invitation), Albert Goldman (by invitation), Harvard University.

Factors determining the duration of the consecutive phases of the cardiac cycle: Carl J. Wiggers, Western Reserve University.

Observations on the pathological physiology of circulatory stasis in man: R. W. Scott, City Hospital, Cleveland, Ohio.

The relation of cottonseed poisoning to gossypol: C. L. Alsberg and E. W. Schwartze (by invitation), Bureau of Chemistry, Washington, D. C.

Experimental observations on the ureter: Vincent J. O'Conor (by invitation), and G. B. Wislocki (by invitation), Harvard Medical School.

Observations on the spread of temperature changes in tissues: N. B. Taylor (by invitation), University of Toronto.

An explanation for the increased oxidation following the ingestion of fats and alcohols: W. E. Burge, University of Illinois.

An explanation for the increased oxidation after fertilization during youth, and for its decrease in old age: W. E. Burge and J. Leichsenring (by invitation).

The effect of various temperatures upon blood catalase: O. O. Stoland and Lalia Walling (by invitation), University of Kansas.

Further observations on the results of feeding cotton meal and kernels to animals: Icie G. Macy (by invitation), and N. M. Alter (by invitation), Yale University and Western Pennsylvania Hospital.

The gastrin theory put to physiological test: A. C. Ivy, Loyola Medical School, Chicago.

The intestinal mechanism primarily stimulated by sodium carbonate: Frederick S. Hammett (by invitation), Wistar Institute of Anatomy, Philadelphia.

The effect of pituitary extract upon the peripheral vasomotor mechanism and on diuresis: O. O. Stoland, J. H. Korb (by invitation), R. M. Isenberger (by invitation), and R. W. Urie (by invitation), University of Kansas.

The quantitative measurement of static control in standing: W. R. Miles, Carnegie Nutrition Laboratory, Boston.

Blood pressure and electrocardiographic changes in the dog during extreme oxygen want: C. W. Greene and N. C. Gilbert (by invitation), Northwestern University Medical School.

PAPERS READ BY TITLE

A study of the influence of various circulatory conditions on the reaction to the low oxygen of rebreathing: Edward C. Schneider.

Endocrinological studies of the prostate gland: D. I. Macht.

Movements of the empty stomach of necturus: T. L. Patterson (by invitation).

Notes on muscle fatigue in frog when immersed in various concentrations of the alcohols: F. M. Baldwin.

Report on the daily analysis of outdoor (city) air for 18 months: W. M. Boothby and K. Sandiford (by invitation).

The effect of starvation on the catalase content: W. E. Burge and J. Leichsenring (by invitation).

Dioestrous changes in the mammary gland of the opossum: Carl Hartman (by invitation).

A new method for determining cardiac output: J. A. E. Eyster and W. J. Meek, University of Wisconsin.

Contributions to our knowledge of the center of gravity in man: Percy M. Dawson and coworkers.

Minimal reflex contractions in tenuissimus of the cat, investigated by Pratt's optical method: E. L. Porter, Western Reserve University.

Production of ammonia in muscle under different conditions: Shiro Tashiro and Olive P. Lee (by invitation).

The distribution of particulate matter after intravenous injection: C. K. Drinker, L. A. Shaw (by invitation) and C. C. Lund (by invitation), Harvard Medical School.

P-D time and D-P time of the carotid pulse of women: W. P. Lombard and O. M. Cope (by invitation), University of Michigan.

The relation of the cerebral hemispheres to the sympathetic nervous system: Fred. T. Rogers, Baylor University.

A quantitative study of the effect of magnesium chloride on nerve: Esther Creilsheimer (by invitation), and C. E. Shepherd (by invitation), University of Minnesota.

The inhibitory effects of vagus stimulation on gastric mobility in the turtle: Fred. T. Rogers and Z. Berkovitz (by invitation), Baylor University.

Experimental gigantism produced by feeding anterior lobes of hypophysis: E. Uhlenhuth (by invitation), Rockefeller Institute, New York.

DEMONSTRATIONS

Exhibition of old books of anatomy and physiology: A. B. Luckhardt, University of Chicago.

The adaptation of Adrian's narcosis experiment to class-room instruction on nerve conduction: Alexander Forbes, Harvard University.

The capillary circulation in the cat's ear: Donald R. Hooker, Johns Hopkins University.

The action of gastrin: R. W. Keeton, F. C. Koch and A. B. Luckhardt, University of Chicago.

Vasomotor nerves in the lungs of amphibia and reptila: A. B. Luckhardt and A. J. Carlson.

Models to illustrate the principles of ophthalmoscopy and retinoscopy: A. B. Luckhardt.

Appetite secretion of gastric juice in man: A. J. Carlson.

Lung automatism and lung reflexes: A. B. Luckhardt and A. J. Carlson.

Effects of prolonged low protein diet in rats: E. C. Turner (by invitation), University of Chicago.

"Fat Soluble A" in chicken fat and orange peel: Ethel Cooper (by invitation), University of Chicago.

Symbiosis in the study of deficiency diseases: Lester Dragstedt (by invitation), University of Chicago.

An anesthesia apparatus: D. E. Jackson.

An anesthesia apparatus for animal experiments: Gerard Raap (by invitation) and D. E. Jackson.

The utilization of the ciliary ganglion in physiology and pharmacology: A. R. Cooper (by invitation) and J. F. Groot (by invitation).

Demonstration of Wright's new method for the study of leucocytic chemotaxis: Elizabeth P. Wolf (by invitation).

Charts illustrating (a) *effects of spells of rest on physical efficiency.* (b) *An examination of indices of circulatory efficiency:* Percy M. Dawson, Lucy A. Wallrich (by invitation) and Frances V. Kupperman (by invitation), University of Wisconsin.

Chas. W. Greene,
Secretary

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SCIENCE

Friday, April 29, 1921

CONTENTS

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REORGANIZATION OF THE WORK OF THE FEDERAL GOVERNMENT[1]

There is one problem of the new administration that has received the attention and thought of the organized engineers of America for many years past. This is the problem of the reorganization of the federal government. The inadequacy, the wastefulness, and the inefficiency of our federal organization was evident enough under pre-war conditions. These inadequacies, these inefficiencies, these wastes were exhibited to the country during the war at the cost of millions.

Congress has placed the problem in the hands of a very able congressional joint committee. But if this joint committee succeeds in securing the imminently necessary results it will only be by full insistent support to it by public opinion. Many attempts have been made at reorganization before but all of them have gone to the same crematory— the interminable differences in opinion among the executive and legislative officials over details.

To any student of federal organization, one sweeping and fundamental necessity stands out above all others, and that is that the administrative units of the government must be re-grouped so as to give each of the great departments more nearly a single purpose. The hodge-podge of aims in certain administrative branches is scarcely believable when we consider our national pride and skill in organization. Such functions as public domain, public works, assistance to veterans, public health functions, aids to navigation, to industry, to trade, purchasing of major supplies, are each and every one scattered over from four to eight departments, most of which are devoted to some other major purpose.

[1] Summary of an address by Mr. Herbert Hoover, made at the dinner given in his honor by the Engineers' Club of Philadelphia, April 16.

Economies can be accomplished from a public point of view by an elimination of the overlap in these different units of administration through unification into groups of similar purpose. The real economy to the nation, however, does not lie here, however great this may be, but it lies in their more effective functioning in their daily relation to the public. The extra cost imposed upon business in general in the determination of the relation of any particular business to the different functions of the govenment, with the unnecessarily duplicating interferences and demands is a real charge on national wealth, probably as great in some directions as the actual costs of the administrations themselves.

Of equal importance with economy is to secure effective concentration of government effort into service to the community. No constructive vision or policies can be built around a national service directed by from two to ten cabinet members, more especially when this particular purpose is a side issue to all of them. No better example of this exists than the deplorable handling of our relations to our veterans.

There are other reasons that render reorganization imperative. The changed economic situation of the world demands that the functions of the government in aid to commerce and industry be given more concentration and wider scope.

The enlarged activities of the government as a result of the war greatly affect certain departments. The Treasury to-day as the fiscal office of the government must handle an annual budget of $5,000,000,000 as compared with $1,000,000,000 pre-war. Activities of the Army have increased from a budget of $200,000,000 to $400,000,000; activities of the Navy have increased from a budget of $125,000,000 to $425,000,000. Thus the burden and responsibilities for the major purposes of these departments have been enormously increased. I believe it is the consensus of opinion of the gentlemen conducting these departments that in the interests of efficiency they should not be called to responsibility for the administration of at least some of the matters not pertinent to their major functions which clutter their departments.

We have also some confusion between executive, advisory, and semi-judicial functions. One of the tendencies of government both local and national during the last twenty years has been to add executive functions to commissions and boards created primarily for advisory or regulatory purposes. It requires no argument with our business public that the executive functions can not rise to high efficiency in the hands of government boards where from the very nature of things each member has a separate responsibility to the public and is primarily engaged in a semi-judicial function.

Furthermore, during the last few years there has been a great growth of independent agencies in the government reporting directly to the president until his office is overburdened almost beyond the point of endurance. The original and sound conception was that the executive functions should be reported up to the president directly through his cabinet officials. Not only do these outside functions to-day overburden the president, but they render coordination with executive departments extremely difficult. It is neither possible nor advisable to place all these outside organizations into the departments, but much could be done to mitigate the situation.

One of the great steps in federal reorganization is the erection of a budget system, with its necessary reorganization of the congressional committees. There can be no doubt as to the early accomplishment of this great reform, but it will not serve its real purpose until the departments have been reorganized so that they represent a common purpose. Without this, congress will never have before it budgets showing the expenditure of the government in its relation to any particular function.

I have daily evidence in the Department of Commerce of all these forces. The question of governmental aids to navigation is not by any means one of the principal functions of our government, but it must be a sore trial

to the hardy mariner. He must obtain his domestic charts from the Department of Commerce, his foreign charts from the Navy Department, and his nautical almanac from the Naval Observatory—and he will in some circumstances get sailing directions from the Army. In a fog he may get radio signals from both the Navy and Commerce, and listen to fog horns and look for lights and buoys provided him by Commerce; if he sinks his life is saved by the Treasury. He will anchor at the direction of the Army, who rely upon the Treasury to enforce their will. His boilers and lifeboats are inspected by the Department of Commerce; his crew is certified by one bureau in commerce, signed off in the presence of another, and inspected at sailing by the Treasury, and on arrival by the Department of Labor.

It is possible to relate the same sort of story in our governmental relations to industry to our domestic and foreign commerce.

The moral of all this is that economy could be made by placing most of these functions under one head, not only economy to the government but to the mariner. Congress would know what it spends in aid to navigation and the government could develop definite policies in giving proper assistance and lastly could remove from the hardy mariner's mind his well-founded contempt for the government as a business organization.

The economic changes in the world, growing out of the war, and their reflex upon our trade and industry make it vital if we are to maintain our standards of living against increasing ferocity of competition that we shall concentrate and enlarge our national effort in the aid, protection, stimulation and perfection of our industrial and commercial life. There can be no real Department of Commerce or commercial policies to these broad purposes so long as the instrumentalities of the government bearing on these questions lie in half a dozen departments.

We want no paternalism in government. We do need in government aid to business in a collective sense. In a department we do not want to either engage in business or to regulate business. We need a department that can give prompt and accurate diagnosis from both a foreign and domestic point of view of economic events, of economic tendencies; of economic ills; that can promptly and accurately survey economic opportunity, economic discrimination and opposition; that can give scientific advice and assistance and stability to industry in furnishing it with prompt and accurate data upon production, supplies and consumption; that can cooperate with it in finding standards and simplifications; that can by broad study promote national conversation in industry and the elimination of waste; that can study and ventilate the commercial side of our power possibilities; that can study and advise national policies in development of rail, water and overseas transportation; that, in fact covers, so far as government functions can cover, the broad commercial problems of trade, industry and transportation. This can be accomplished more by coordination of existing governmental facilities than by increased expenditures.

THE AMERICAN ENGINEERING COUNCIL[1]

In these days when societies multiply and increase it is a fair question to ask whether there is need for such an organization as the Federated American Engineering Societies. That many believe there is such a need is attested by the large number of societies that have already joined the organization and by the promise that others will come in. Aside from this, however, it is well to clear our minds as to just what the aims of this organization may be and what it may hope to accomplish. I am not unmindful of the vast amount of useful work that has been done by individual engineering societies in this country, not only in the somewhat varied lines for

[1] Address by Dexter S. Kimball, dean of the college of engineering of Cornell University and vice-president of the American Engineering Council, at the dinner given by the Engineers' Club of Philadelphia, April 16, in honor of Mr. Herbert Hoover.

which they have been specifically organized, but also in a broader way as affecting state and national issues. At the best, however, these individual organizations are concerned, for the most part, with service to the individual, and while not confined to such, these societies have been able to work in a broad way for the public welfare only through combined organization of some kind. All thinking engineers are aware of the inefficient manner in which much of the engineering and industrial features of our government, city, state and national, are conducted, and the experience of our local engineering societies in working for a better and more economical policy in the conduct of these affairs in cities, as well as the success that has attended such organizations, as the Engineering Council, in trying to assist on questions of broader scope all lead to the belief that a Federated Engineering Society, which can speak for all engineers in the important affairs concerning which we are justified in speaking, must be productive of beneficial results. It is almost axiomatic that in a nation such as ours where industry is the great factor of our existence these statements must be true. Industry is the life of our nation, and engineering is the backbone of industry. Surely if any class of men have a right, or better still, a duty, to band themselves together for the betterment of the fundamental industrial principles of our nation, engineers, using the term in a broad sense, have full justification for so doing. These are matters of common knowledge to all engineers and scarcely need to be defended or explained.

There is, however, a much greater and deeper reason in my opinion why we have need for a society of this kind. We are all prone to think that the problems of our day and date are peculiar and unlike any that have gone before. As a matter of fact, history teaches us just the contrary and a superficial examination of any of the great civilizations that have preceeded us will show that basicly they differ very little from the one that we now enjoy. The great fundamental principle of all civilizations is division of labor; at once the most effective tool that man has ever devised, it is at the same time the cause of his greatest difficulties. Because, wherever division of labor is employed, coordinated effort necessarily follows. We know of no civilizations built up by a single individual, though Robinson Crusoe is reported to have made a very good effort. Nor do we know of civilizations that were built up by a limited number of persons. Basicly, civilization is possible only where there is a wide use of division of labor accompanied by coordinated effort. But with coordinated effort comes always the difficult problem of awarding fairly and justly the fruits of labor, and from the beginning of time men have wrestled unsuccessfully with the problem of "what is mine and what is thine." As far back as we can read history we find industrial codes aimed at the solution of this difficult problem. The Mosaic code, based on a much more ancient Egyptian code, the remarkable code of Hamurabi and a still more ancient code recently discovered, all bear witness that this problem is very ancient indeed and has always been the one great problem incident to the use of division of labor and the building up of a civilization. The solutions offered by these ancient codes are for the most part of a legal character, often very arbitrary and intended more as a means of keeping the peace rather than as a solution of the problem on the ground of merit and justice. And to a large extent we have inherited these viewpoints in our modern industrial codes.

Wherein does modern industry differ from these ancient civilizations? The advent of the modern machine era and the extension of the use of scientific methods have carried division of labor to a degree undreamed of by our ancestors a few hundred years ago. If the ancient civilizations were complex ours is infinitely more so and the difficulty of defining "what is mine and what is thine" has increased many fold.

And the solutions we have been offered for this problem are many and curious. The advocates of single tax, prohibition and women's rights, of various kinds of tariff,

of various schemes of taxation are all quite sure that if their measures are enacted the millennium would be here. If the ancient civilizations were complex ours is chaotic, and further extension of our complex industrial system makes this personal problem more and more difficult.

Out of this chaotic condition, however, three viewpoints to-day stand out above all others and are well worthy of carful consideration. The first is the conviction that is rapidly taking root in the minds of thinking men that industry should be considered a means of supporting the human race, and not as a means of personal corporate or state profit: the conviction furthermore that all men are entitled to a certain amount of physical, mental and spiritual well-being, and that the nation which can develop such well-being is the one that will endure.

The second is a conviction that no adjustment of these difficult industrial matters can be enduring that is not based upon justice. It is true that justice varies with time and place, but whatever stands for justice at the time and place considered, is the only basis on which enduring industrial adjustment can rest. This conviction differs from the old legal viewpoint quite markedly, and it is well illustrated in our changed point of view concerning accident compensation. For hundreds of years accident compensation was based on legal verdicts inherited by us from old English common law and having sometimes little to do with justice. The modern compensation law is an effort to adjust these matters on the ground of justice and the fair deal.

The third conviction is that there can be no justice where there is no knowledge. Any one who has read carefully the history of industrial disputes during the last few years can not fail to be impressed with the truth of this statement. Wherever a wide knowledge of fact can be obtained, adjustments usually are not difficult, but an enduring adjustment can never be accomplished where facts are not known.

What has this to do with the work of the engineer? A very great deal indeed. A few years ago the engineer was looked upon as one who built and designed machines or structures. With the growth of his technical and scientific background it has become necessary for him to assume the management of industry and to-day he stands as the foremost figure in industrial management. This has brought him for the first time in close touch with the human element of industry and face to face with the great problem of the distribution of wealth. Up till recent times he was not expected to know of these matters and much less was he expected to have any wise ideas as to the solution of the problem. It should be remembered, however, that the engineer in thus enlarging his field has brought with him the most powerful mental tool that the human has devised, and which we call commonly the "scientific method." With this method he has conquered and subdued nature. At the present time he is teaching the human race a better and more efficient means of organizing industry. It remains to be seen whether he can apply this method to the solution of the old time problem of "what is mine and what is thine." It should be remembered that this problem has been wrestled with by many able minds but it will also be remembered that many of those who have given much time and thought to these problems did not have the intimate knowledge of industry, and of those who work in industry that is the possession of the engineer to-day. If he undertakes the solution of this problem with the same energy and vision that he has applied to fields that he has already conquered, I am hopeful for the result.

I see, therefore, in the Federated Engineering Societies something more than an organization to assist city, state and nation in the solution of technical problems. I see in it an opportunity for the engineer to study and to solve the last remaining problem of civilization. I see in the society a means of gathering data on the industrial problem such as we have not possessed and in general of obtaining that knowledge, which as I have

already indicated, is absolutely essential to this great problem.

And I am not without hope that the engineer will qualify for this work. There are many indications that their ideas are stirring in the minds of forward-looking men. At the last election Mr. James Hartness, well known as an engineer and inventor, was elected to the Gubernatorial chair of the State of Vermont, an honor, so far as I know, that has never before been conferred upon an engineer. And it was with the greatest satisfaction and pleasure that engineers, not only in this country, but elsewhere, viewed the selection of Mr. Herbert Hoover as Secretary of Commerce. These are pioneer workers in a field hitherto controlled by the lawyer and the politician, and their progress will be watched with the keenest interest and sympathy by all engineers. Of the success of their mission no engineer has the slightest doubt, for we are well aware that these men will bring to the problems of state the methods that have enabled the engineer to subdue nature and build up civilization.

Can there be any question that back of a movement as great as this we need an all-embracing Society of Engineers; a society whose business it will be to foster the solution of the great problems of industry which are the problems of the engineer. The functions of such a society will differentiate sharply from those of an individual society in that as before stated, the individual society is more likely to deal with service to the individual. This society is organized for service to the nation. It is a challenge to national service. There is no question in my mind that it has a bright future and is worthy of the support of engineers of all kinds and in all places.

PLAGIARISMS

There have been published in recent numbers of Science[1] communications from correspondents more or less involving the interest which revolves around what we are apt to call plagiarism. They are concerned for the most part with matters of not very serious import in scientific circles and the communications are marked by courtesy and good humor. These amiable features are sometimes absent in the more earnest and specialized realms of research and the whole subject is only too often conducive to unfortunate and wearying controversy and to permanent and deplorable enmities between the best of men and those least likely, one would think, knowingly to rob a fellowman of credit for original work. One not himself drawn into the heat of such conflicts is often led to believe that a more thorough understanding of some of the implications and correlations, a more just appreciation of the numerous underlying springs which move the human mind would modify it. A more constant keeping in view the history of science, a realization of how numerous are the expositions of facts before the world becomes attentive even to the most obvious of them, would cause these deplorable incidents to become less frequent. The character of the recent outbreak in Science was mild and it was devoid of bitterness, as most incidents are which present such examples of the humor and worldly common sense of the participants, as these communications do. The chances of unfortunate consequences being remote it is perhaps an opportune time to say something of the broader aspects of the subject of plagiarism.

Its wide affiliations are best appreciated in an analysis of the underlying principles to which I have referred. Many will be disposed to criticize what may seem the too wide significance I give to the term. Many look upon it only as one of evil import. However, it is easier to expand its usual limitations a little than to find or invent a name which after all would only here and there overlap the commonly accepted outlines of the usual term.

Its most sinister acceptation interests us but little. When a man affixes his name to a long essay or a book which another man has written it would perhaps be better to call it thievery. I remember one such instance

[1] Science, January 14, 1921; February 11, 1921; March 4, 1921.

occurring many years ago. I only introduce reference to it here because I am reminded that in defense of the quite undeniable fact there was advanced an explanation which sometimes, in less flagrant cases, has to be seriously considered. The culprit when convicted pleaded that he had imbibed the author's ideas from lectures he had heard him deliver and essays of his he had read, so that when he came to write these unconsciously flowed from his pen. This too is one of the implications of plagiarism, but alas! in this particular instance it was a question not of ideas—these were in no way notable—but of two or three thousand words repeated in the same sequence, certainly a monstrous accomplishment for the subconscious. With this aspect of plagiarism I am not here concerned, as I am not writing on the underlying causes of crime.

Where indeed shall we draw the line between a peccadillo and crime? At a not very remote period in the past there was no patent law, no copyright, far less any code punishing purloining even of words to say nothing of ideas. There seems only comparatively recently to have arisen a public opinion condemning such transgressions. They were once scarcely censurable. In the time of the Renaissance there was an entirely different point of view. Their equivalent for research was then the digging up of buried treasure out of ancient literature. This was so universal that it seemed a sort of affectation to be bringing in allusions to the derivation even of transliterations from ancient authors, forcing on the reader, as it were, the recognition that the writer was accurately and intimately acquainted with ancient models. It was taken for granted of any idea or incident that some Aristotle or Plato or Pliny had originated or transmitted it. Why bore the reader by continually reminding him of it? Indeed such impatience occasionally becomes vocal in the modern reader from this annoyance. Among the ancient authors Pliny was the only one who grouped his references in separate bibliographical categories. He alone, so far as I know, in his "Natural History" went about the matter in a way that approaches our systematic bibliographies, and he took good care to save the reader from the weariness of continual textual indications of the sources of his astounding statements. Any story, however good, any lesson, however valuable, any humor, however infectious it otherwise would be, is apt to evaporate under less careful supervision. The literature of the subject is what the rushed researcher today first skips, the details next and the "conclusions," least of all. The form of a modern research article at best is a grisly horror. I do not know if the man has been born yet who can avoid bibliography, details and conclusions, and yet have his essay stand forth in shining attractiveness in its exposition of original work in science. One sometimes wishes to be born again when that blessed time is a reality. It is therefore hardly fair to group the conventional essay of modern science with real literature. The real masters of science sometimes approach it; they very rarely indeed attain it.

But in order to pursue our inquiry into the nature of plagiarisms, it is in general literature for the most part we must seek our illustrations. When Molière wrote his comedy "Le Médecin Malgré Lui," he put in the mouth of his own characters the discourse, found in Rabelais, of Panurge, as to the man who had married a mute wife. It is not worth while to pursue the joke further backward, as we shall find other illustrations easily enough, but those who saw Joe Jefferson play "Rip van Winkle" in Boucicault's adaptation of Irving's tale will remember the soliloquy of Rip on the mountain as to the vision of a happy married life, excited by the contemplation of the mute dwarfs he met there. Petrarch furnished Molière with other scenes, not the ideas alone but a considerable stretch of word for word translation. I have traced this back, not quite so literally perhaps, to Pliny and evidently through him to Pindar. The ancient Greek legends represent the complaint of Zeus finding practical executive attention in the smiting of Æsculapius for transgressing the permissible limi-

tations of his art when he resurrected the dead. Later the complaint of Pliny and Petrarch also was that the doctors took unethical liberties with their opportunities. Pindar, Pliny, Petrarch, Molière, even Dr. Rabelais himself by inference, lash the doctors with the bitterest invectives for transgressions, some of which we admit to-day are daily committed against the ethics of the profession. It becomes stereotyped in Pliny, Petrarch and Molière.

Whether well done or badly done it is always paid alike. . . . A shoemaker in making a pair of shoes can't spoil a piece of leather without paying for it, but at this business when we spoil a man it does not cost us a cent.

Even Socrates has the same jibe put in his mouth by Plato, and to this Petrarch manages to allude, but to our unwritten modern ethical standards it is all flagrant plagiarism. As to medicine much of this continual abuse of it in ancient and modern satire is due to the underlying vice in its social regulation. It is the sole one of human activities wherein its practitioners are admonished, nay forced so far as possible, to work directly against their own material interests. No punishment is too severe, if we could only get at him, for the criminal who tries to further his commercial interests by the unnecessary worry and botheration to a patient, whom nature is better able to treat than the doctor. Is there any doubt of the occasional justification for such complaint? What is there against the other impostors of commerce? For them such conduct is ethical business. As for medical men attempting to stimulate their business by setting plagues agoing, that is unthinkable. Indeed the evolution of public health preservation is making daily more clear the anomaly of this age-long status of practitioners of medicine, and daily one sees more or less abortive attempts in the direction of change. Now the underlying cause of all this plagiarism in the satires and jibes against the doctors is the broad one of maladjustment of a certain social agency. It is the continued protest of society, falling into fairly narrow channels of expression it is true, but it is also true that no one censures Molière or Petrarch, or ever did censure them for using ancient jokes and jibes as their own.[2]

Now the thread that runs through the stories of the effect wrought on the layman's mind by comparing the ideas aroused by viewing for the first time other worlds than ours through the telescope is that which the preacher seizes to emphasize the glory of God and the insignificance of man, whom he has created. That has been dinged into the consciousness of countless generations of men, ever more insistently, as modern science has made it more and more manifest. The suggestion of a parity becomes daily more grotesque. This grotesqueness finds frequent issue in words and it is not difficult to imagine that even the words are closely similar, when the humor of the thought strikes the same spot in the observer's mental machine.

Let me take a more concrete example. Does any one suppose that when Mark Twain wrote the extremely amusing dialogue in Tom Sawyer Abroad between Nigger Jim and the hero he was plagiarising Pliny? The former had a poor opinion of painters. One of them "was paintin' dat old brindle cow wid de near horn gone—you knows de one I means. . . . He say when he git her painted de pictur's worth a hundred dollars. Mars Tom, he could a got de cow for fifteen." So Pliny's barbarian Gaul with the long hair, when at Rome was asked on his glancing at a masterpiece of an old slave leaning on his staff what he would give for it in cash. "I would not give a farthing even for the slave"[3] was his contemptuous reply. It is apparent that such a joke is always lying close to the surface through all the ages since man made his drawings on the walls of the dark caves at Altamira and that is the way with the joke about the stars.

Lawyers are always writing to the astronomers for knowledge of when the moon might

[2] "Ancient jibes at the doctors," *New York Medical Record*, September 12, 1903.

[3] Pliny, "Historia Naturalis," Liber XXXV., 8 Ed., Silling, Vol. V., p. 211.

have revealed or when it could not have revealed crime to the night-wandering witness. There is nothing remarkable that Lincoln should have cornered his witness as well as Alcibiades by a device that lay near the surface ever since man became a sublunar biped. But neither is there anything remarkable, indeed I believe the biographies assert it as fact, that Lincoln in his youth was a reader of Plutarch's lives, possibly of Chamber's "Book of Days" too, where one can meet with the same tale. At any rate the stories always amuse, when first met with, and wherever met with often instruct. They should not be suppressed by uncharitable charges of plagiarism, because it does not seem worth while, even if the charge is correct, to spoil the story and wipe out its humor by the introduction of clumsy and pedantic references.

The interest in anthropological problems as well as in those of ethnology is so specialized and within their own lines is so absorbing that the light psychology might throw on them has been somewhat neglected—very much so until very recently. And yet Tylor's ground thought was that psychology plays a large part in anthropology even if the human mind is everywhere ab initio of the same nature. He, or some of his followers at least, are not even disposed to allow as much fundamental differentiation as they apply to the shape of the skull or that of the nose. However that may be they have compelled us to acknowledge that it reacts very much in the same way to the same environment and the same stimuli and this places us at once in view of the link, some may think rather tenuous, which attaches ethnology to plagiarism. I hope with the expansion I have given to that term, in what has preceded, this is at least discernible. I tried once to show[4] that, starting with primitive man's idea of disease etiology, the demons of disease became those of heresy or their first cousins, and inasmuch as a good purge was a good way to get rid of disease devils, so it was also for false doctrine, vile thoughts, evil emotions, pride, jealously, injustice. So early and so firmly bound together in this channel in all the languages of modern civilized races became the association that "purge" still persists in them all as applied to mental and religious and legal categories ages after the devils of disease had disappeared from medicine, a quite grotesque and absurd correlation between widely different concepts in modern thought. One stares with surprise, both in Pliny[5] and in Schoolcraft's[6] account of American Indians, at the menstruating woman going around crops naked at night to chase away the vermin from the corn, or was it in both cases some fertility rite that was observed and misinterpreted? We are scarcely less astonished to find the plumed serpent in American aboriginal religion more or less closely paralleling that of the Asiatic. I do not know if any hooded snake may have existed or may still exist in America to account for this detail of coincidence, very astonishing unless we think of the same environmental influences in India and America. We get no trace of the deadliness of anything resembling that of the cobra as having ever moved the mind of man in America to stand in awe before its power and worship it. But whether the American savage brought the plumed snake from eastern Asia in medicine bundles across the Straits of Behring or across the Pacific or whether his imagination created the coincidence, still we see two of the principles prominently associated with plagiarism here in this distant ethnological territory brought into play. One is the persistance with which the mind moves in channels once entered, the other is the promptness with which it enters those channels once it is placed in a certain environment. I fancy this exemplification torn with some violence from a foreign field is helpful in making us realize how the tendency to plagiarism is one deeply, immutably rooted

4 "The Demons of Heresy and the Demons of Disease in the Processes of Thought," *New York Medical Journal*, February 23, 1918.

5 Pliny, "Historia Naturalis," Liber XXVIII., Ed. Sillig, Vol. IV., p. 277.

6 Schoolcraft, Henry R., "The Indian Tribes of the United States," Part 5, p. 70.

in the human mind and though some may be disposed to say this is nothing but another word for original sin, I am sure most will rather be disposed to believe that a very large amount of the so-called plagiarism can be traced to sources quite outside the volitions and intentions of the transgressor.

Notwithstanding this, some may consider, extremely charitable view which we should all take when confronted with evidence that seems a little disconcerting at times, it behooves us all, when we think we have a bright new idea, or a brand new joke, or a bit of new truth laboriously unearthed in research, to search our inner consciousness as well as our environment for the origin of it. At any rate worldly wisdom should teach us not too rashly to forget the precaution of leaving the way open for the claims of others which we may have unintentionally overlooked.

Jonathan Wright, M.D.

CONSERVATION CONFERENCE ON RESOURCES OF INTERIOR WATERS

As indicated by a recent preliminary announcement, Hon. Herbert Hoover, secretary of Commerce, has called a conference at the Fisheries Biological Station, Fairport, Iowa, June 8–10, 1921, for consideration of the conservation of resources of interior waters.

Acting under instructions from Mr. Hoover, the Committee on Organization and Plans has prepared the following outline of the scope and character of the conference.

It is assumed that our water courses, our lakes and ponds not only should serve as avenues of transportation, and channels for removal or reservoirs for storage of surplus surface drainage, but should also continue to provide food and other necessities of life and to furnish the means of essential recreation. It is evident that, with growth in population and with progressive industrial development, the public waters are becoming decreasingly fit to serve these latter ends. It is important, then, to ascertain if the decline in usefulness of the waters is inevitable, and, if it is not, to discover and apply the means of bringing about improvement. There is a certain community of interest among groups (anglers, commercial fishermen, sanitary engineers and others) that are commonly conscious only of special interests, but as yet there has been no unity of purpose, no concert of effort to serve a common interest. It is certain that the accomplishment of the purpose of each group is conditioned, not only upon public sympathy and support, but upon the cooperative service of scientists representing biology, chemistry and physics, and engineers representing sanitation, hydrology and navigation.

That the conference now called should be as constructive and practical as possible, it is proposed to concentrate attention upon the following principal topics: (1) the depletion of fish and shellfish, its causes and possible remedies; (2) the preservation, value and appropriate utilization of swamp and shore areas; (3) the organization of effort to secure an early beginning upon a constructive program of betterment.

It is believed that the conference may be most effective in accomplishing its ends if it be the occasion, not for a few special addresses, but rather for informal and free discussion from every point of view. It is proposed that on each day there shall be two sessions, morning and afternoon, respectively, with ample intervals between sessions for personal interviews, demonstrations or recreation. Opportunity will be afforded in the evening for special meetings to disclose topics of interest to particular groups or to all. As no talk is expected to exceed ten minutes, opportunity is allowed for the most open discussion. Following is the outline of program:

Wednesday, June 8. 10 A.M. and 2 P.M.

Subject: Depletion of aquatic resources, causes and remedial measures (including principles rather than details of legislative protection). Discussion from the standpoint of the sportsman, the commercial fisherman, the dealer or manufacturer, the biologist, the fish-culturist and the sanitary engineer.

Wednesday evening is left open for special topics arising in course of the discussion of the day.

Thursday, June 9. 10 A.M. and 1:30 P.M.

Subject: The value of swamp and shore areas and their utilization as fish and game preserves, for the cultivation of aquatic animals and plants, as reservoirs of food for aquatic animals, and as nurseries for young fish. Consideration may also be given to the additional value of submerged lands in relation to food control, forestry, agriculture and sanitation.

On Thursday evening there will be a special meeting for consideration of the opportunities and needs of research stations.

Friday, June 10. 10 A.M. and 2 P.M.

Subject: Organization of effort to determine what plans of procedure may be immediately followed to further progress in conserving resources of interior waters.

The discussion may be from the points of view of cooperation in scientific research, the training of men to prosecute investigations, the education of the public, the reconciliation of conflicting group interests, the union of effort to secure adoption of appropriate conservation measures, and the possibility of periodic gatherings for promotion of harmonious action.

Through the cordial cooperation of a local committee, special arrangements will be made for utilization of the intervals between meetings in interesting demonstrations pertaining to the topics of the conference, in trips to neighboring points of interest, or in other means of diversion and recreation.

Throughout the conference meals will be served at a small charge based upon actual cost in the dining room of the Biological Station. Lodging without charge will be available in the laboratory or in tents or other temporary quarters. The nearest hotels are found in Muscatine, Iowa, a distance of 8 miles and Davenport 20 miles from Fairport.

All persons expecting to attend are advised to communicate in advance with R. L. Barney, Director of the Fisheries Biological Station, Fairport, Iowa, or J. E. Krouse, Davenport, Iowa, Chairman, Local Committee on Arrangements, in order that suitable reservations may be made for accommodations.

R. E. Coker,
V. E. Shelford,
J. E. Krouse,
A. S. Pearse,
F. A. Stromster,
R. L. Barney,
Committee on Organization

SCIENTIFIC EVENTS

THE AMERICAN ENGINEERING COUNCIL AND MR. HOOVER

The American Engineering Council of the Federated American Engineering Societies met on April 16 at the Engineers Club of Philadelphia. Members attending were: Herbert Hoover, president; Calvert Townley, vice-president, representing A. I. E. E.; J. Parke Channing, vice-president, representing A. I. M. M. E.; E. Ludlow, president A. I. M. M. E.; F. J. Miller, past president A. S. M. E.; M. L. Cooke, Taylor Society; Wm. McClellan, A. I. E. E.; A. S. Dwight, A. I. M. M. E.; A. M. Greene, A. S. M E., dean of the School of Engineering, Troy Polytechnic Institute; S. H. McCrory, A. S. Agricultural Engineers; W. W. Varney, Baltimore Engineers Club; J. F. Oberlin, Cleveland Engineering Society; O. H. Koch, Technical Club of Dallas; D. S. Kimball, vice-president, dean of School of Engineering, Cornell, A. S. M. E.; Gardner S. Williams, Engineering Society of Grand Rapids; C. F. Scott, A. I. E. E., School of Engineering, Yale University; W. B. Powell, Buffalo Engineering Society; W. E. Rolfe, vice-president, Associated Engineering Societies, St. Louis; L. B. Stillwell, A. I. E. E.; L. P. Alford, A. S. M. E.; H. W. Buck, past president A. I. E. E.; E. S. Carman, A. S. M. E., Cleveland; Philip N. Moore, A. I. M. M. E., Washington.

Mr. Hoover resigned the presidency, giving as his reasons the fact that the American Engineering Council by its constitution was necessarily engaged in furthering national activities which involve legislation; and that he as a member of the executive branch of the government could not consistently direct such

activity as an officer of the council. The council, in a resolution of regret at Mr. Hoover's retirement, voted its appreciation of his leadership during the organization period of the council and his initiation of policies and effort.

A dinner, arranged in honor of Mr. Hoover by the Engineers Club of Philadelphia, representing more than 4,600 engineers in the Philadelphia District, was the culminating event of the meeting. Guilliaem Aertsen, president of the club, presented Mr. Hoover with a certificate of honorary membership, which read: "The Engineers Club of Philadelphia, by unanimous vote of its directors, in council, the eleventh day of November, 1919, desiring to express its fullest appreciation of the eminence attained by him in the field of engineering, and his great service to humanity, hereby confers upon Herbert Hoover honorary membership with life tenure of all the rights and privileges thereto belonging."

The addresses made by Mr. Hoover and Dean Dexter S. Kimball, of Cornell University, are printed above. Speeches were also made by Wharton Pepper, Esq., Col. William A. Glasgow and John C. Trautwine, Jr.

THE CLASSIFICATION AND SALARIES OF GOVERNMENT EMPLOYEES

A bill providing for reclassification of government employees was offered in the Senate on April 18 by Senator Smoot of Utah. The bill has been drafted by Senator Smoot after a conference with other members of the senate appropriations committee and with efficiency experts of the government.

The bill provides eighteen grades in the government service, with salaries ranging from $360 to those above $7,500. It is provided that the head of each department and establishment shall, under rules and regulations prescribed by the president, allocate the positions in each department or establishment to grades in accordance with the schedule contained in the bill.

The head of each department and establishment within the salary range of the popular grade will determine the salary to be paid each employee by comparing his efficiency with the average efficiency of all employees assigned to the same work, or, if no other employees are engaged upon the same or comparable work, by comparing the efficiency of the employees with the efficiency which reasonably should be expected.

The salaries of all employees in each department or establishment fixed in accordance with the proposed law shall become effective on the first day of the third month following the date of approval of the act, and no employee shall thereafter be paid a salary exceeding the maximum rate or less than the minimum rate prescribed for the grade to which his position is allocated.

The upper eight grades are defined as follows:

Grade 11—Salary range, $2,460 to $3,000. The number of classes of employment is eighteen, ranging from supervision of and laying out of the work of a group dealing with tariff rate questions to the engraving on copper plate of topographic maps or similar work where there is much technical detail, repairing defective and worn plates.

Grade 12—Salary range, $2,700 to $3,300. The number of classes, seven, ranging from responsibility for the accounting work of a small government accounting organization to the construction and suggestion of improvements and new designs in instruments of precision, requiring familiarity with practical astronomy.

Grade 13—Salary range, $3,000 to $3,600. The number of classes of employment, eleven, ranging from the supervisor of an entire system of accounts in a large office to the administrative control over the clerical force of a large independent establishment or a major bureau or division of a department.

Grade 14—Salary range, $3,300 to $3,900. Three classes of employment, directing editorial work of a department and being responsible for the conduct of a minor subdivision of a technical, scientific or professional organization, and designing and constructing instruments of precision.

Grade 15—Salary range, $3,600 to $4,500. The number of classes, ten, ranging from the supervision and responsibility for accounting work of an organization requiring extensive accounting operations to the responsibility of receiving and

paying money in one of the largest government organizations.

Grade 16—Salary range, $4,500 to $5,700. The number of classes of employment, five, ranging from general supervision over design and installation of accounting systems to administrative control of the clerical force and responsibility for the general business operations of one of the largest departments.

Grade 17—Salary range, $5,700 to $7,500. Two classes, chief law officer of a department, commission or other independent government establishment, and having responsible charge of a major subdivision of a technical, scientific or professional organization.

Grade 18—Salary range, all above $7,500. Employments include all technical, scientific, professional and executive employments whose characteristics and requirements are superior to those in the lower grades. No salary in excess of $7,500 may be paid to any persons unless specifically authorized by Congress.

THE MUSEUMS AND COLLECTIONS OF YALE UNIVERSITY

THE Yale Corporation has approved the plan of the University Council for a permanent Committee on University Museums to include all officers in charge of museum collections and for the appointment of a corporation committee to meet this Committee on University Museums to consider "the relation of the museums and of their buildings to each other, the organization of the collections within the respective divisions and the functions of the Museums Committee."

A survey recently made shows that the various collections of the university, in addition to those of the School of the Fine Arts and the Library, are more extensive than is generally realized. The following list, the arrangement of which is tentative, shows the various collections and the names of their curators:

I. Natural History:
   - Mineralogy—Dana, Ford.
   - Geology and Invertebrate Paleontology—Schuchert, Dunbar.
   - Vertebrate Paleontology and Osteology—Lull.
   - Botany—Evans.
   - Forestry—Record.
   - Zoology—Coe.

II. Anthropological:
   - General Anthropology—McCurdy.
   - Peruvian Expedition Collection—Bingham.
   - Musical Instruments—D. S. Smith.
   - Military—Hoyle.

III. Oriental and Classical:
   - Syro-Arabian—Torrey.
   - Babylonian—Clay.
   - Egyptian—Clay (acting).
   - Ægean—Baur.
   - Indian—Archer.
   - East and Central Asiatic—Williams.
   - Japanese—Asakawa.
   - Numismatic—Newell.

IV. Fine Arts—Kendall.

V. Library—Keogh.

THE HECKSCHER FUND GRANTS OF CORNELL UNIVERSITY

THE Heckscher Research Council has recently announced its first series of grants, as follows:

To Professor Joseph Q. Adams, Jr., Ph.D., '06, a sum sufficient to secure a substitute for him for the first half of 1921–22 in order that he may be released from teaching and enabled to complete his "Life of William Shakespeare," on which he has been for some time engaged.

To Professor Charles C. Bidwell, Ph.D., '14, $2,500 to enable him to carry on cryogenic measurements, the money to be used to provide a substitute for carrying on his work during the first half of 1921–22 and to cover such additional expenses as the investigation may involve.

To Professor J. Chester Bradley, '06, a sum not exceeding $700 to cover the cost of preparing illustrations and otherwise completing a work embodying the results of investigations of the wing venation of Hymenoptera.

To Professor Arthur W. Browne, Ph.D., '03, $1,800 to enable him to engage a competent assistant for two semesters for investigations of certain problems in the field of the oxidation of hydrazine, especially in non-aqueous solutions.

To Professor Louis M. Dennis, $350 for the purpose of engaging an assistant from March 1 to July 1 to carry on investigations on the separation of the isotropes of lead by chemical processes. Also $2,000 for the purpose of engaging a well trained assistant for one year, to devote all his

time to the investigation of the preparation and properties of germanium and its compounds.

To Professor Frank L. Fairbanks, '10, $500 for the purpose of developing and completing a traction dynamometer.

To Professor Simon H. Gage, '77, and Pierre A. Fish, '90, $250 for colored plates needed in completing a work on the digestion and assimilation of fat in the human and the animal body.

To Professor Vladimir Karapetoff $200 or such part as is needed for an assistant and materials in carrying on investigations on mechanical aids in the design of electrical machinery and lines.

To Professors William R. Orndorff and Roswell C. Gibbs, '06, $2,525 to pay for the services of an assistant on half time during 1921–22 and on full time during the summer and for apparatus to be used by him in connection with the investigation of the absorption spectra of certain organic compounds.

To Professor Floyd K. Richtmyer, '04, a sum not to exceed $1,800 for an assistant for one year to devote all his time to investigations of the laws of the absorption of x-rays, and $1,000 for the purchase of apparatus.

To Professor Ernest W. Schoder, Ph.D., '03, a sum sufficient to provide a substitute for him during the first half of 1921–22 in order that he may prepare for publication the results of investigations in hydraulics made by himself and the late Professor Kenneth B. Turner, '03.

To Professor Sutherland Simpson $100 to enable him to continue his investigations into the functions of the thyroid and parathyroid glands.

To Professor Albert H. Wright, '04, $500 for investigations of the life history of North American frogs, toads and tree toads.

To Professor Virgil Snyder, '90–92 Grad., a sum not exceeding $1,200 to provide a substitute for him during the second half of 1921–22 and thus enable him to continue during that time his studies of algebraic correspondences.

To Professor Wallace Notestein $1,800 for an assistant during the summer and the year 1921–22 to help in his work of editing various historical documents in connection with the study of the Parliamentary history of England.

To Harry S. Vandiver $500 to support, during the summer, investigations on the subject of algebraic numbers.

These grants amount to about $20,725.

The council has postponed the consideration of all requests for grants in aid of publication until it is possible to consider in detail the whole subject of the publication of results of research and its relation to the purposes of the Heckscher Foundation.

SCIENTIFIC NOTES AND NEWS

The American Philosophical Society has elected members as follows: Herman V. Ames, Philadelphia; George David Birkhoff, Cambridge; John J. Carty, Short Hills, N. J.; Frank M. Chapman, New York; Henry Crew, Evanston, Ill.; Benjamin M. Duggar, St. Louis; John Marshall Gest, Philadelphia; Charles Homer Haskins, Cambridge; Lawrence J. Henderson, Cambridge; J. Bertram Lippincott, Philadelphia; Hideyo Noguchi, New York; Thomas B. Osborne, New Haven; Charles J. Rhodes, Philadelphia; Vesto M. Slipher, Flagstaff, Ariz.; David White, Washington.

Prince Albert of Monaco gave the evening address at the annual meeting of the National Academy of Sciences on April 23, and the address was followed by a reception in the U. S. National Museum. At the dinner of the academy on the following evening Prince Albert was presented with the Alexander Agassiz gold medal, awarded in recognition of his promotion of oceanographical research.

Dr. Albert Einstein, to whom Columbia University last year awarded the Barnard medal on the recommendation of the National Academy of Sciences, was present at the meeting of the academy, and responded to an address of welcome from President Walcott just before the adjournment of the Tuesday morning session. Dr. Einstein also spoke at the academy dinner.

Rear Admiral William C. Braisted, U. S. N., retired, former surgeon general of the Navy, has been elected president of the Philadelphia College of Pharmacy. He is this year president of the American Medical Association.

Dr. William S. Thayer, professor of medicine at the Johns Hopkins University and

physician-in-chief of the Johns Hopkins Hospital, has resigned.

PROFESSOR ERNEST W. BROWN, of Yale University, has been elected a correspondent of the French Academy of Science.

THE Vienna Medical Society at a recent meeting elected to honorary membership as token of gratitude for their efforts in promoting the public health of Austria, Mr. Herbert Hoover, of Washington, D. C., and Dr. F. Ferrière, the vice-president of the International Red Cross, at Geneva.

THE University of Dublin has conferred the honorary degree of doctor of science upon A. A. Michelson, professor of physics in the University of Chicago; W. M. Bayliss, professor of general physiology in University College, London, and E. Borel, professor of the theory of functions at the Sorbonne, Paris.

PROFESSOR C. S. SHERRINGTON, president of the Royal Society, has been elected a member of the Athenæum Club under the provision for the election of persons "of distinguished eminence in science, literature, the arts, or for public service."

THE Royal medals of the Royal Geographical Society have been awarded as follows: Founder's medal to Mr. Vilhjalmur Stefansson, "for his distinguished services to the Dominion of Canada in the exploration of the Arctic Ocean"; and Patron's medal to General Bourgeois, senator for Alsace, "for his long and eminent services to geography and geodesy." The council has made the other awards as follows: The Murchison grant to Commandant Maury, for his surveys in the Belgian Congo; the Bach grant to Miss Marian Newbigin, for her contribution to geography, particularly of the Balkans; the Cuthbert Peek grant to Captain J. B. L. Noel, for his reconnaissance of the eastern approaches to Mount Everest and other geographical work; and the Gill memorial to Lieutenant Colonel M. N. MacLeod, R.E., for his contribution to the theory of survey from air photographs.

DR. OSKAR KLOTZ, professor of pathology in the University of Pittsburgh Medical School, has been appointed representative of the International Health Board of the Rockefeller Foundation for medical research work and education of São Paulo, Brazil, serving as director of a pathologic institute.

THE Food Research Institute, established by the Carnegie Corporation and Stanford University with Dr. C. L. Alsberg, formerly chief of the Bureau of Chemistry, United States Department of Agriculture as director, has appointed, to be associated with Dr. Alsberg, Alonzo E. Taylor, professor of physiological chemistry at the University of Pennsylvania, and Joseph S. Davies, assistant professor of economics at Harvard University. The directors will have authority to determine the scientific policies of the Institute and the problems to be studied. Leland Stanford, Jr., University has appointed as an advisory committee Herbert Hoover, Julius M. Barnes, Dr. J. C. Merriam, J. R. Howard, Dr. William M. Jardine and George Reeding.

DR. A. S. HITCHCOCK, systematic agrostologist of the U. S. Department of Agriculture, leaves about May 1 for an extended trip to the Orient. He will visit the Philippines, Japan, China, Indo-China, Singapore and Java, returning about January 1. He will study the grasses of the regions visited and will gather data especially for a revision of the bamboos of the world.

PROFESSOR MARSTON TAYLOR BOGERT, of Columbia University, gave an address at New York University on April 13, on "Science and disarmament."

UNIVERSITY AND EDUCATIONAL NEWS

A MAINTENANCE fund of $30,000 a year has been promised to the Albany Medical College on condition that a similar amount is raised each year by the trustees. The Rockefeller Foundation will give $20,000; the General Electric Company $5,000, and Dr. Charles Alexander Richmond, president of Union University, $5,000. The money this year must be raised by June 1 to make the $30,000 available.

IT is announced that the Ontario government will give immediate financial aid to the universities of the province as follows: University of Toronto, $900,000; Queen's at Kings-

ton, $325,000; the Western at London, $200,000.

The Pennsylvania State College has received from the children of the late J. Roberts Lowrie the gift of his herbarium. The collection comprises 2,750 mounted varieties representing 144 families and 707 genera.

With a portion of the funds at their disposal the trustees of the Captain Scott Memorial Fund have decided to establish a Polar Research Institute in connection with the new department of geography in the University of Cambridge.

The exchange agreement, established before the war, between Buenos Aires medical schools and Paris schools, has been renewed. In August of this year Professors Marcel Labbé and G. Brumpt will go to Buenos Aires to give lecture courses. The Buenos Aires school will send to Paris either heads of clinics or laboratories to take postgraduate courses in Paris.

The board of trustees of the Armour Institute of Technology has announced the appointment of Howard M. Raymond as acting president of that institution to fill temporarily the vacancy caused by the recent death of Dr. F. W. Gunsaulus.

Frederick H. Sibley, formerly professor of mechanical engineering at the University of Kansas, has been elected dean of the college of engineering at the University ofNevada. The college includes the four schools of civil, electrical and mechanical engineering and the Mackay School of Mines.

Dr. Oskar Bandisch, formerly privat-docent in the University of Zurich, has accepted an appointment as research associate in biochemistry in Yale University. Dr. Bandisch received his training in organic chemistry at the Technische Hochschule in Zurich under Professor Baumberger, and has contributed much original work dealing with problems of plant assimilation and the influence of light on chemical reactions. His work at Yale will be entirely in the graduate school.

Dr. Shepherd I. Franz and Dr. R. A. Cutting, respectively professor and associate professor of physiology at the George Washington University Medical School, have resigned.

DISCUSSION AND CORRESPONDENCE

ON THE USE OF THE TERMS "DENUDATION," "EROSION," "CORROSION" AND "CORRASION"

In 1911 J. W. Gregory called attention to the looseness with which the above terms were used in geological and geographical literature,[1] and suggested certain restrictions in their meanings. Although the confusion in the use of these terms has been generally appreciated by geologists, Gregory's suggestions have met with little favor, and no effort seems to have been made to bring about a uniformity of usage. In fact, a review of various text-books which have appeared since the publication of Gregory's article indicates that the confusion is growing worse.

While the definitions suggested by Gregory are open to strong objection, yet the existing ambiguity in the use of such important geological terms can not fail to be bewildering to students and authorities alike, and calls for some remedial action. A few quotations taken at random from recent text-books will emphasize this fact.

1. According to Tarr and Martin[2] denudation consists of weathering plus erosion, and erosion is further defined as involving "removal, transportation and deposition of rock fragments," though on p. 115 erosion is spoken of as the combined work of corrasion and corrosion, no mention being made of deposition. These authors apparently define corrasion as the mechanical degradation of rock by river water, and corrosion as the chemical removal of *solid* rock (pp. 114, 115) though the definitions are not at all clear.

2. Pirsson[3] limits erosion to "the formation of rock débris and its removal" and gives no definition of denudation. Corrasion he defines as the action of a stream in rasping

[1] *Geographical Journal*, Vol. 37, 1911, pp. 189–195.

[2] "College Physiography," 1914, p. 18.

[3] Pirsson and Schuchert, "Textbook of Geology," 1915, p. 31.

away the country rock *beneath* and *beside* it, "thus cutting an ever-deepening trench" (p. 37).

3. Cleland[4] refers to the confusion in the use of the terms corrasion, abrasion, corrosion, erosion and denudation in a footnote on pages 83 and 84, and then defines corrasion and abrasion as synonymous and meaning the detachment of rock particles as a result of wear; corrosion as the work done by solution; erosion as the sum of corrasion and corrosion, and denudation as a general term for the lowering of the land surface by any agency.

4. Grabau,[5] following Walther, defines erosion as clastation plus ablation, or the breaking up of rock material and its removal. Denudation is the removal of weathered and loose mantle rock and is a subordinate part of the process of ablation, which includes in addition corrasion, quarrying and corrosion. The former is defined as a "filing process" which may be accomplished by wind, running water, ice, waves or organisms, while corrosion is chemical removal by air (= evaporation), water, heat or organisms.

5. De Martonne[6] uses the term erosion in a broad sense but does not define it. Corrasion he limits to the wearing action of *wind*-driven particles, as typically illustrated in arid regions (pp. 660, 664).

6. Kayser[7] describes erosion as the mechanical work of water, and denudation as the sum of erosion and weathering, which latter term includes both chemical and mechanical action. Corrasion he defines in the same way as de Martonne (p. 240), both authors here following Walther and von Richthofen.

7. Park[8] defines denudation as "the wearing away, wasting, or breaking up of the land surface, whereby the general level of the land is lowered." Erosion, according to this author, is embraced within the term denudation and is somewhat vaguely defined as referring to "the more active and obvious wear and tear carried on by the sea, by streams, rivers and glaciers" (p. 15). Corrosion is "eating away of rock due to chemical solution, hence . . . is frequently used to denote chemical denudation" (p. 16). On page 34 the same writer refers to corrasion as "a variant of corrosion used by some writers to denote the vertical excavation performed by a stream," but recommends the use of erosion in its place.

The above quotations are only a few out of many and include only books published in the last ten years, yet they show an amazing divergence of views. This will be better illustrated by the following summary:

Out of a total of 7 authors quoted,

Denudation is defined by 5:

- as weathering plus removal, transportation and deposition of rock fragments; (1)
- as a general term for the lowering of the land surface by any agency; (2)
- as the removal of loose mantle rock (1)
- as weathering plus the mechanical work of water (1).

Erosion is defined by 6:

- as removal, transportation and deposition of rock fragments (1)
- as the formation and removal of rock débris (2)
- as the mechanical work of water (1)
- as rock wear plus solution (1)
- as the more active and obvious wear and tear performed by streams, rivers and glaciers and by the sea (1)

Corrasion is defined by 6:

- as mechanical degradation by rivers (2)
- as the detachment of rock particles by wear of any agent (2)
- as the wear caused by wind-driven particles (2)

One author rejects the term altogether, holding it equivalent to erosion.

Corrosion is defined by 4:

[4] "Geology, Physical and Historical," 1916.

[5] "Principles of Stratigraphy," 1913, pp. 17, 18.

[6] "Traité de Géographie Physique," Second Edition, 1913.

[7] "Allgemeine Geologie," third edition, 1909, Vol. I., p. 260.

[8] "Textbook of Geology," 1914.

as work done by solution (3)
as chemical removal by all agents (1)

Comment on these examples is scarcely necessary, but it might be added that this list does not by any means exhaust the definitions that might be quoted, as reference to Gregory's article will show.

The definitions suggested by Gregory are as follows:

denudation = the wearing down of the land by any agency whatever.

erosion = the widespread lowering of the land by wind, rain and weather, and by rivers and glaciers acting *laterally*.

corrosion = the excavation by rivers and glaciers of their beds.

corrasion dismiss as a synonym for corrosion.

These definitions are unsatisfactory in many respects. To separate the lateral and vertical degrading action of rivers and include only the former under the term erosion is not only unnecessary, but highly artificial. Indeed, a satisfactory definition of erosion will be an exceedingly difficult matter to accomplish, for the reason that the word has come to be used in two different senses: one broad sense in which it signifies the general process of the wasting of the land surface and is thus equivalent to denudation, as exemplified in the definition of Davis,[9] and a much narrower sense common in geological literature in such phrases as "ice erosion," "wind erosion," etc. The only solution of this difficulty would appear to be to use "denudation" for the general process and restrict "erosion" to the narrower meaning of gnawing or cutting away.

A general term for the action of rivers and glaciers on their banks and beds seems desirable, and for this purpose the word corrasion is much preferable to corrosion, since the latter has a distinctly chemical implication. There seems to be, on the other hand, no good reason for using separate terms for the lateral and vertical wearing action of streams and glaciers, since the adjectives lateral and vertical prefixed to corrasion would amply distinguish the two processes.

There would also appear to be room for the term corrosion as used by Grabau to denote the chemical removal of material by any or all agents, solution being a part of this general process, and confined to the action of water.

However these various terms be used eventually, the need of rescue from the hopeless confusion and ambiguity of the present is undeniable. The Geological Society of America found it advisable to standardize the nomenclature of faults; should it not also be the duty of that organization, or, better yet, of an International Congress of Geologists, to take official notice of the ambiguous meanings of the words denudation, erosion, corrasion and corrosion, and establish precise and authoratative definitions of these much-abused terms?

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[9] Davis and Snyder, "Physical Geography," p. 105.

EUCLID OF ALEXANDRIA AND THE BUST OF EUCLID OF MEGARA

During the middle ages and later, it was the ill fortune of Euclid, the mathematician, to have been confounded with Euclid of Megara who lived about a century earlier and was not a mathematician. As if this confusion were not sufficient to tantalize mathematicians in general, another mistake came to be made, involving the same two Euclids. This time a bust found on a Greek coin, which according to numismatic authorities is really aimed to represent Euclid of Megara, came to be published broadcast as the picture of the mathematician of Alexandria. This happened in England where William Whiston, who was Sir Isaac Newton's successor in the Lucasian professorship of mathematics at Cambridge, brought out a school edition of Euclid containing as a frontispiece this bust, said to have been taken from a bronze coin once in the possession of Queen Christina of Sweden.[1] Unfortunately this same picture

[1] For the history of Queen Christina's Coin Collection, consult an article by Hugo Gaebler in the

which on the coin is circumscribed by the name ΜΕΓΑΡΕΩΝ, *i.e.*, of the Megarians, has been published in the United States as representing Euclid the mathematician. This unintentional historical misrepresentation appears in the publication, "A Portfolio of Portraits of Eminent Mathematicians" (1896), issued by the Open Court Publishing Company, in Chicago, a firm which in general has done as much as any other in America to advance a sound knowledge of the history of mathematics. The picture of Euclid of Megara is given as that of the mathematician, Euclid. In the memorandum accompanying the picture occurs the statement, "the name Megara is frequently coupled with his [name] on the early portraits as in this case."

The statement just quoted, in so far as it relates to the coin portrait in question, is in conflict with numismatic authority. A specimen of the coin referred to is in the British Museum and has been described by the great authority on coins, Barclay V. Head, who speaks of this coin as follows:[2]

> ΜΕΓΑΡΕΩΝ. Bearded head of the philosopher Eucleides of Megara, veiled and wearing ear-ring. . . . This remarkable type refers to the story that Eucleides attended the lectures of Socrates in the disguise of a woman, the Athenians having passed a decree that no citizens of Megara should be admitted within their walls. (Aulus Gellius, *Noct. Att.*, VI., 10.)

In his catalogue of Greek coins Head[3] quotes the Latin passage from Aulus Gellius, the Roman writer of the second century A.D., referred to above, who had studied at Athens. The passage tells the story of Euclid's going to Athens disguised in a "tunica longa muliebri" to attend the lectures of Socrates and of his returning to Megara the next day in the same disguise. In this book Head gives the date of the coin as "Cir. 146 B.C. or later"; in his *Historia*, quoted above, he gives, "Imperial Times?". While Head thus expresses uncertainty as to the exact age of the coin, he entertains no doubt as to the head-dress representing woman's apparel that was worn by Euclid of Megara when on his way to and from the lectures of Socrates.

It is therefore established with as great certainty that this coin does not give the bust of the mathematician Euclid as it is established that this mathematician was not Euclid of Megara.

Florian Cajori

University of California

"Corolla Numismatica . . . in Honour of Barclay V. Head," Oxford University Press, 1906, pp. 368–386.

2 "Historia Numorum, a Manual of Greek Numismatics," by Barclay V. Head, Oxford, 1911, p. 394.

3 "Catalogue of Greek Coins, Attica—Megaris—Aegina," by Barclay V. Head, D.C.L., Ph.D. Edited by Reginald Stuart Poole, LL.D., London, 1888, p. 121. See a drawing of the coin in Attica, etc., Plate XXI., 14.

RAINBOW BY MOONLIGHT

To the Editor of Science: In connection with the case of the rainbow at night reported by Frank L. Griffin in Science of March 11, the following case may be of interest: At Burge, Nebraska, a rural post office about eighteen miles southwest of Valentine, on September 4, 1917, at about 9 P.M. a rainbow appeared. The moon had risen about an hour previously and a thunderstorm was coming up in the west, the rest of the sky being clear. A rainbow began to form and it continued to become brighter until a complete arch was formed. It was very distinct, but was nearly white and showed the prismatic colors very faintly if at all.

C. J. Elmore

QUOTATIONS

BRITISH DYESTUFFS CORPORATION

The situation in which the directorate of the British Dyestuffs Corporation finds itself is a remarkable one. At the registration of this company in May, 1919, as a result of amalgamating British Dyes, Ltd., of Huddersfield, with Messrs. Levinstein, Ltd., of Blackley, the appointment of Sir Joseph Turner as

commercial managing director, and of Dr. Herbert Levinstein as technical managing director, was designed to maintain the interests of both groups, and to benefit the united enterprise by the special contribution of knowledge and experience which each of these gentlemen was expected to make. At the meeting of shareholders in Manchester on Friday last it was announced that Sir Joseph Turner and Dr. Levinstein, while retaining their seats on the board, have been superseded as managing directors by Sir Henry Birchenough, the chairman of the corporation, Sir William Alexander, and Mr. Vernon Clay.

It is no reflection on the new managing directors to express the opinion that the position thus disclosed must arouse grave misgiving amongst all those who recognize the foundation of a self-supporting synthetic dye-making industry as a matter of the greatest national importance. Disregarding the woeful absence of harmony which appears to be indicated, the aspect of this rearrangement which causes anxiety to chemists is the fact that, at a time when all the scientific knowledge and commercial energy available in this country should be correlated in a concerted effort to establish an industry which, more than any other, depends for success upon the combination of these factors, two of the most experienced practitioners should be removed from very intimate association therewith.

The proper and perfectly natural request for an investigation put forward by the shareholders met with a cold response from the board, and the declaration by the chairmen that a general meeting is not the occasion for an explanation of such peculiar circumstances is one with which many will sympathize; but the public is entitled to full information at the earliest convenient opportunity. Pending more precise knowledge of the facts, it would not be fair to the late managing directors, or to the board, to pass judgment on their action. If, however, as the published statements at present suggest, incompatibility of temperament is the cause, chemists will regard them as having failed in realizing their responsibility to science at a critical juncture; on the other hand, the board can scarcely escape the reproach of having allowed an impossible situation to continue far beyond the point at which a surgical operation had become an obvious necessity. Having regard to the immense scientific and national interests which are involved in the ultimate success of this enterprise, and to the large sum of public money which has been invested in the corporation, its future conduct demands very careful scrutiny.—*Nature*.

SCIENTIFIC BOOKS

Practical Plant Biochemistry. By Muriel Wheldale Onslow. Cambridge University Press, 1920. Royal 8vo, pp. viii + 178. Price 15s. net.

It is being recognized by students of the plant sciences that a thorough understanding of plant chemistry is essential to the solution of their problems. This knowledge has been usually obtained, on the one hand, from organic chemistry, and on the other, from plant physiology. It is the gap between these two sciences that this book is designed to fill. The author has made a real contribution to the study of plant chemistry. As in her former book on "The Anthocyanin Pigments of Plants," she has presented a very clear and comprehensive discussion; however, in the few pages of the present volume it is impossible to give more than a cursory discussion of the topic. The book is essentially a laboratory manual, which contains well-chosen experiments that have been tested in practical classes. Through these experiments the student learns to extract from the plant itself the chemical compounds of which it is composed and to understand something of their chemical properties. As an introduction to each chapter, there is presented the *fundamental* principles and relationships of the particular class of compounds studied in the experiments.

The volume is divided into the following chapters: I. Introduction. The synthesis of the various classes of compounds, and the chemical reactions by which they are brought

about, are discussed. II. The Colloidal State. It is appropriate that the book should begin with this topic, since it is essential for an understanding of the chemistry of cell protoplasm; but this is the least comprehensive and complete of any of the chapters. The two fundamental types of colloidal solutions, suspensoids and emulsoids, are treated and their characteristic properties illustrated. III. Enzyme Action. The underlying principles of enzyme action are briefly discussed and the behavior of different enzymes illustrated by those contained in yeast. The discussion of other enzymes follows in connection with those chapters dealing with the respective substrates. IV. Carbon Assimilation. It is emphasized that chlorophyll is perhaps the most important factor in plant metabolism. V. Carbohydrates and their Hydrolyzing Enzymes. Of all the subjects in plant chemistry which deserve careful treatment it is that of carbohydrates, and to it the author has devoted more space than to any other. There is a careful consideration of the properties and characteristics of the various carbohydrates, their synthesis and relationships in the plant. The monosaccharides, disaccharides and trisaccharides are most thoroughly treated, the latter under the following topics: pentosans, starches, dextrins, inulin, mannans, galactans, gums, mucilages, pectic substances and celluloses. VI. The Fats and Lipases. VII. Aromatic Compounds and Oxidizing Enzymes. The more widely distributed aromatic plant products are grouped: the phenols and their derivatives; the aromatic alcohols and acids including the tannins; the flavone, flavonol and xanthone pigments; and the anthocyanin pigments. The greater portion of the chapter is devoted to the plant pigments and oxidizing enzymes. VIII. Proteins and Proteases. The properties and chemical reactions by means of which the proteins can be detected are studied, and experiments follow which illustrate the method of extraction of the proteins from characteristic grains and seeds. IX. Glucosides and Glucoside-splitting Enzymes. Besides the glucosides of the pigments previously discussed the cyanophoric glucosides receive chief attention. X. The Plant Bases.

In the preface the author states that the book presents an aspect of plant biochemistry which up to the present time has received very little consideration in teaching. This is not entirely true in America, for at the University of Minnesota there have been offered for several years courses in phytochemistry and biochemical laboratory methods with particular reference to plant products. It is rather a coincidence that the subject matter of our courses should be similar, beginning with the colloidal state of matter and following with the classes of compounds found in plants. These courses through lectures and laboratory have presented to the student the same viewpoint for which this book was designed. Mrs. Onslow is to be commended for her pioneer work in the publication of a text on this important subject. From the mechanical standpoint the book is up to the usual standard of the publications of the Cambridge University Press. It is to be regretted, however, that in all probability the price will prevent it being used in many cases where it could profitably be employed.

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Anthropometry. By Aleš Hrdlička. Wistar Institute of Anatomy and Biology, Philadelphia. Pp. 163.

Anthropologists and all other workers who have occasion to make use of anthropometry have long been handicapped by the lack of any adequate and up-to-date manual of anthropometry. Now, at length, they have at their disposal a compact and comprehensive treatise on the subject written by one of the most experienced and competent investigators in the field, Dr. Aleš Hrdlička, curator of the Division of Physical Anthropology, U. S. National Museum. As a laboratory manual in physical anthropology and as a handbook for the use of field investigators of physical characters in man, this book should prove invaluable.

The work very properly begins with an annotated translation of the Monaco and Geneva Agreements for the Unification of Anthropometric Measurements. There follows a concise treatment of the preliminaries of the subject, such as preparation, instruments, landmarks, recording grouping of subjects, estimation of age, admixture of blood, pathological conditions, etc. The various topics are handled with clarity and include much original data in regard to general methods. There is a sane appraisal of the various anthropometric instruments and accessories employed in investigations.

The section on the anthropometry of the living deals with a selected list of the most important measurements and observations as determined by the experience of the author. The directions given are very clear and include many practical suggestions tending to promote facility of observation and accuracy of result.

The anthropometry of the skeleton is satisfactorily treated and includes a description of the invaluable system of visual observations elaborated by the author. In the opinion of the reviewer this standardization of morphological observations constitutes a contribution to anthropometric method of first importance, and the section dealing with it might advantageously be expanded. It is to be hoped that Dr. Hrdlička may find time to publish elsewhere a series of articles illustrating the normal or medium development of the various morphological characters and the extremes of their variations. Such illustrations, together with a discussion of the extent and significance of variations, would provide a standard basis for judging the degree of development of immensurable characters. At the present time the value of such observations is dependent upon the accuracy and experience of the individual investigator. It is becoming apparent to physical anthropologists that morphological differences of detail that do not lend themselves to measurement are of primary importance in distinguishing races. Many important functional adaptations belong also to this category of features which must be described rather than measured.

Perhaps it may be said that the greatest value of this work on anthropometry lies in the fact that it represents the perfected methods of one of the most skilled and best qualified practitioners of the science. Experts may differ as to the value of this or that measurement, or may prefer their own technique in individual cases, but this book is in general reliable and conclusive. A careful follower of its methods can not fail to secure completely adequate physical data in any general anthropometric investigation.

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Harvard University

SPECIAL ARTICLES

SUBEPITHELIAL GLYCOGEN CELLS IN EMBRYO AND RECENTLY HATCHED FISH

In April, 1912, while studying the development of the yellow perch (*Perca flavescens*) I discovered numerous cells filled with glycogen located just below the flat epithelium covering the surface of the embryo. The embryos in which I demonstrated these cells had been developing in the laboratory for twelve days. Upon the addition of a few drops of tincture of iodine to the water in the saucer in which the embryos were contained it was noticed, upon microscopical examination, that there were many round or oval cells, stained a reddish brown, scattered over the surface of the embryo, and especially marked in the fins. I have repeatedly studied these cells in the yellow perch and some other species of fish since I first observed them, and I have found them so interesting that I wish to make a record of some of my findings.

The embryos of the yellow perch are especially well adapted for microscopic examination, as they are exceedingly transparent, and retain their transparency to an advanced stage of development. The development of the eggs takes place rapidly at the ordinary temperature of the laboratory. At the end of the fourth or the beginning of the fifth day after the first division of the egg the embryo begins to make spontaneous movements of its body,

and the rudimentary heart commences to beat. No glycogen cells can be detected at this time, but about the beginning of the sixth day they appear as minute dark brown spots after the application of the dilute iodine solution. The glycogen cells increase in size and become more granular during the further development of the fish. At the time of the appearance of the cells the embryos are covered with a single layer of very thin flat epithelium. The intercellular substance of the epithelial cells can be easily and strikingly stained, after the application of a weak iodine solution and washing in water, by immersing the animal in a dilute aqueous solution of methylene blue for a short time. The blue staining fluid forms a dark precipitate with the iodine in the cement substance, and forms zigzag lines which delimit the cells in the clearest manner. The dark lines may be seen to cross the glycogen cells in many places, indicating that these cells are beneath the epithelial covering.

The glycogen cells are usually more or less elliptical and their dimensions vary with their stage of development. When they first appear their diameters may vary within the limits of 3μ and 10μ. At this time the protoplasm of the cells forms a ring surrounding a large central vacuole containing the glycogen granules. One part of the ring is usually thickened, and contains an elongated elliptical or crescentic nucleus. As the cells enlarge with the advanced development of the fish their vacuoles encroach on the protoplasm until the cells are converted into microscopic sacs of glycogen, in the walls of which a long elliptical or reniform nucleus can usually be found. At this stage the diameters of the cells may be 15μ to 25μ, and the granules, stained a mahogany color with iodine, are chiefly found just below the cell membrane. A number of these granules may coalesce and form a rod-shaped body in the interior of the cell. Sometimes three of the rods unite in the shape of a Y. The stained granules of glycogen dissolve with considerable rapidity in the water containing the preparation, and many of them disappear after a few minutes, leaving the thin cell membrane containing the nucleus. A very weak solution of iodine formed by adding a drop or two of the tincture to 5 c.c. of water gives the cells their characteristic color in a few seconds if the animal has been removed from the egg envelopes. If the embryos retain their gelatinous envelope they are stained in a few minutes, and it is easy to follow the gradual staining of the cells before the animals are killed by the iodine.

At the time of the first appearance of the glycogen cells there are no blood globules in circulation, but these are first seen a day or two later. At a little later period the liver is formed, and may be stained a brick red by the iodine solution. The liver cells do not contain glycogen granules but are diffusely stained a lighter and more reddish color than the subepithelial glycogen cells.

After a certain degree of development of the fish the number of the glycogen cells becomes gradually lessened by absorption. As I have had the perch under observation for only a limited time after hatching I have never witnessed the complete disappearance of the cells. In and after the third week of development their number becomes much smaller. At that time the glycogen cells of the tail may be crowded into its edge, and those of the pectoral fins arranged in columns radiating in the direction of the striation. This change in position is probably due to the growth of other tissue elements which displace the glycogen cells. In advanced development I have noticed in the tail fin many smaller mesoblastic cells which are not stained with iodine.

I have found many glycogen cells, very similar to those of the yellow perch, in recently hatched pike-perch or wall-eyed pike, and in the small-mouthed black bass, but some differences in the appearance of the cells in the different species, and in the solubility of their glycogen granules were noted. The glycogen cells of the pike-perch are coarsely granular, and their glycogen dissolves very rapidly in the dilute iodine solution. The nuclei of the cells are not so apparent as those of the yellow perch. The glycogen cells of the pike-perch may be seen under the

microscope as light spots without the iodine treatment, and an enormous number of the cells are scattered over the yolk sac. The cells of the small-mouthed black bass are large and contain much glycogen which dissolves very readily in water after iodine staining. I have noted in pike-perch which have been kept under observation for a considerable time that their glycogen cells become greatly diminished in number. I have not been successful in finding the glycogen cells in all species of fish. I have never been able to discover them in *Fundulus*, and have sought for them in vain in recently hatched smelt. They evidently act as temporary reservoirs of glycogen, but why they are present in some species of recently hatched fish, and not in others, is not apparent.

If it should be discovered that these peculiar cells can be isolated and satisfactorily cultivated in artificial media, they will offer most promising material for studying experimentally the formation of glycogen.

Frederick W. Ellis

Monson, Mass.,
August 23, 1920

THE OVARIAN CYCLE OF SWINE

Most of our information regarding the changes in the mammalian ovary during the various events of the reproductive cycle has been gained from study of the laboratory rodents and small carnivores. The domestic ungulates, on account of their large size and commercial value, have been neglected in this respect, although they promise certain advantages because of the simplicity of their ovarian structure and the regular, outspoken appearance of œstrus.

The only attempt to follow the history of the ripening follicles and the corpora lutea of an ungulate, with material of known history, is that recently published by Max Küpfer of Zurich,[1] who made use of the municipal abattoir of that city to procure a large series of ovaries of the cow. He was able to obtain records of the last appearance of œstrus in a certain number of animals (apparently 33) and has given a set of handsome plates illustrating the rise and retrogression of the corpus luteum. From the gross appearances and from measurements (no microscopic studies were made) Küpfer states that the interœstral period of 21 days may be divided into two parts. During the first 10–11 days after ovulation the corpus luteum is slowly reaching its full size, and thereafter it is in a state of retrogression which continues throughout the next interval, until by the time of the second following ovulation (42 days) the corpus luteum is macroscopically insignificant. The ovaries of animals undergoing uninterrupted œstrus cycles will therefore contain the follicles and corpora lutea of two or three periods, at successive stages of growth and retrogression.

The present writer has been endeavoring to piece out a similar account of the pig, in order to provide an anatomical basis for the physiological relations of ovary, ovum, and uterus in this species, and has published[2] a description of the mature follicles and developing corpora lutea up to the tenth or eleventh day, but has been unable, until the present, on account of conditions of the meat-packing trade, to follow the animals longer than this time. The lacking material has now been supplied, through the cooperation of Mr. W. N. Cooper, manager of the American Feeding Company of Baltimore, at whose large piggery farm a series of 22 sows has been obtained covering practically every day of the 21-day cycle.

The story as read from these specimens is a simple one, as will be seen from the accompanying diagram. It appears that mature ovaries of non-pregnant animals contain a reserve stock of follicles of 5 mm. diameter or

[1] Küpfer, Max, "Beiträge zur Morphologie der weiblichen Geschlechtsorgane bei den Säugetieren," *Denksschr. d. Schweiz. Naturf. Gesellsch.*, 1920, Bd. LVI.

[2] Corner, G. W., "On the origin of the corpus luteum of the sow from both granulosa and theca interna," *Amer. Jour. Anat.*, 1920, Vol. 26, pp. 117–183.

less. One or two days before the onset of œstrus some of the follicles rapidly enlarge to the full diameter of 7 to 10 mm., and the enclosed ova pass through the preliminary stages of maturation. Ovulation occurs on the second of the three days of œstrus; the ova are three days en route through the Fallopian tube and pass into the uterus on the fourth day. If not fertilized they degenerate in utero about the seventh or eighth day after ovulation. The corpora lutea, as already described, reach full histological complexity about the seventh day, by which time

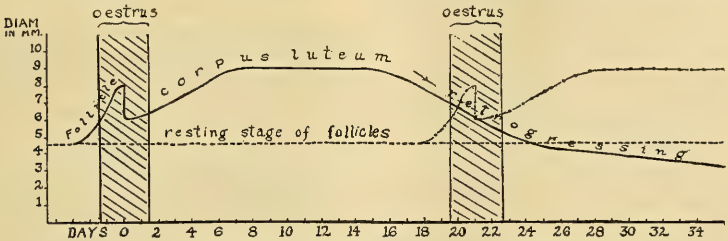

Fig. 1.
Diagram representing the ovarian cycle of the nonpregnant sow.

they have attained a diameter of 9 mm. The new specimens show that they remain in a state of full development, without obvious further change, until the fourteenth or fifteenth day after discharge of the follicles, and then begin a retrogression which is initiated by a sudden disintegration of the granulosa lutein cells, which have formed the chief bulk of the organ. In a few days more the corpora consist only of connective tissue containing in its meshes a few lipoid-laden cells; and by the time of the next ovulation they have diminished in size to a diameter of 6 mm. During the second interœstral interval after their formation they shrink still further, until at the age of 40 days they are but 2 or 2.5 mm. in diameter. After this they are not readily distinguishable from other ovarian tissues in the gross, and microscopically are so far degenerated that one does not feel able to separate them from atretic follicles.

When the pig's ova are fertilized, the embryos gain attachment to the uterine wall between the tenth and fifteenth day after ovulation. It is a most important fact, therefore, that the corpus luteum persists until the fourteenth or fifteenth day, for this finding harmonizes with the current hypothesis that the corpus luteum exercises an effect upon the uterus, preparing it for implantation. The duration of the corpus luteum is quite variable in different species, but in none has it been found less than the time required for attachment of the embryos. Another supposition with regard to the function of the corpus luteum, that it serves, while present, to restrain the growth of follicles, is also borne out by our observations, as far as they go, for it will be noticed that a new group of follicles passes beyond the resting dimension only after the degeneration of the last corpora is under way.

A full account of these studies will form part of a monograph on cyclic changes in the ovaries and uterus of the pig, now in preparation.

George W. Corner
Johns Hopkins Medical School

THE NATIONAL ACADEMY OF SCIENCES

The annual meeting of the National Academy of Sciences was held at the Natural History Building, U. S. National Museum, in Washington on April 25, 26 and 27, 1921.

The preliminary program of scientific sessions open to the public follows.

MONDAY, APRIL 25

Afternoon Session

Ultimate rational units (illustrated): GILBERT N. LEWIS.

The quantum law and the Doppler effect: WILLIAM DUANE.

Preliminary measurements of the effect of high pressures on the thermal conductivities of liquids (illustrated): P. W. BRIDGMAN.

The stratification of suspended particles (illustrated): C. E. MENDENHALL and MAX MASON.

Transmission characteristics of the submarine cable (illustrated): J. R. CARSON and J. J. GILBERT (introduced by J. J. Carty and F. B. Jewett).

Radiation from transmission lines: J. R. CARSON (introduced by J. J. Carty and F. B. Jewett).

Application of the principle of similitude to the hydraulic problem of the surge chamber (illustrated): W. F. DURAND.

Theories of osmotic pressure; Comments on the Borelius space-lattice theory of the metallic state: E. H. HALL.

Metamorphism in meteorites (illustrated): G. P. MERRILL (introduced by Whitman Cross).

The Island of Tagula (New Guinea), its satellites and coral reefs; The shallow seas of Australasia: W. M. DAVIS.

On the radiation of energy from coils in wireless telegraphy; On the vibrations of gun-barrels; On the problem of steering an automobile around a corner: A. G. WEBSTER.

Evening Session

Address by His Serene Highness Albert I., Prince of Monaco, Agassiz medalist, Auditorium U. S. National Museum. Reception to the Prince, Galleries, U. S. National Museum.

TUESDAY, APRIL 26

Morning Session

A model of the solar gravitational field: EDWARD KASNER.

On the problem of three or more bodies: GEORGE D. BIRKHOFF.

Quaternions and their generalizations: L. E. DICKSON.

Investigations in algebra and number theory: L. E. DICKSON.

On the approximate solutions in integers of a set of linear equations: H. F. BLICHFELDT.

A provisional theory of new stars: H. N. RUSSELL.

The compilation of star catalogues by means of a doublet camera (illustrated): F. SCHLESINGER.

The National Research Council: VERNON KELLOGG.

The order of the stars (illustrated): W. S. ADAMS.

Cooking with solar heat on Mt. Wilson (illustrated): C. G. ABBOT.

The evolution of matter: F. W. CLARKE.

The differences between variable series: FRANZ BOAS.

Life of James Hall, of Albany, geologist and paleontologist, 1811–1890 (by title): J. M. CLARKE.

Afternoon Session

The classification of animals: AUSTIN H. CLARK.

Attempts to acclimatize Aphelinus mali in France, South Africa, New Zealand and Uruguay (illustrated): L. O. HOWARD.

Note on structure of the trilobite (illustrated): C. D. WALCOTT.

Origin and history of the Ursidae or bears in the Western Hemisphere, with particular reference to the bearing of this question on problems of geographical history (illustrated): J. C. MERRIAM.

The evolution, phylogeny and classification of the Proboscidea (illustrated): H. F. OSBORN.

Experiments in epidemiology: SIMON FLEXNER.

Effect of administering various simple metabolites upon the heat production of the dog (illustrated): GRAHAM LUSK.

The physical and chemical behavior of proteins (illustrated): JACQUES LOEB.

The skin temperature of Pachyderms (illustrated): FRANCIS G. BENEDICT, EDWARD L. FOX and MARION L. BAKER.

The temperature factor in phytopathology (illustrated): L. R. JONES.

Results of feeding experiments with mixtures of food stuffs in unusual proportions (illustrated): T. B. OSBORNE and L. B. MENDEL.

Population (illustrated): C. B. DAVENPORT.

Measuring higher grades of intelligence: E. L. THORNDIKE.

A study of specific forces of mortality: RAYMOND PEARL and CHARMIAN HOWELL.

C. G. ABBOT,
Home Secretary

SMITHSONIAN INSTITUTION,
WASHINGTON

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE EQUILIBRIUM FUNCTIONS OF THE INTERNAL EAR[1]

IN this paper I have not attempted to survey the whole range of present-day problems on the functions of the labyrinth but have confined myself to some phases of two fundamental questions. (1) What and how much differentiation of function can be proved to exist in the different labryinthine structures concerned in equilibrium? (2) How does movement or change of position of the body give rise to the excitation process in the labyrinth?

I wish to state at the outset that merely for the sake of brevity specific mention will not be made of the reasons for assigning the functions discussed to the inner ear rather than to the movement of retinal images or to other sources of sensory stimuli, but must have it understood that those possible errors have not been left uncontrolled. Furthermore I have dealt with the phenomena objectively, because the experimental work which can throw light on these questions has necessarily been done upon animals in which the postulation of subjective sensations is unsafe or unnecessary. Furthermore I have not been unmindful of the fact that the reactions in the form of compensatory movements and forced positions include the simultaneous activity of many muscle groups, but I have used the compensatory movements of the eyes as the most convenient index of the labyrinthine reflexes, and also as the simplest to describe.

The labyrinth of the higher vertebrates must be used in the solution of many yet unsolved problems, but for the two fundamental questions now before us it presents insuperable difficulties. On the other hand the ears

[1] Read before a joint session of the American Society of Naturalists and American Society of Zoologists, December 30, 1920.

of Selachians are extremely favorable objects for experiment because of the relatively large size of their parts, their anatomical arrangements which permit the stimulation or extirpation of single portions, the ease and clearness with which operations can be performed through the cartilaginous skull, and the machine-like definiteness with which compensatory movements occur in these animals.

The compensatory movements of the eyes and fins of the dogfish were first accurately described by Loeb (1891). Lee (1893) made a very detailed study of these movements in response to rotation about the different body axes, and laid emphasis on the precision with which similar movements resulted from stimulation of the ampullæ of the different canals.

I. THE SEMICIRCULAR CANALS

(a) *Stimulation Experiments*

Lee's description of the results of stimulation of the individual ampullæ is very specific and I (1910) could confirm it in every particular. In brief the results may be thus stated: Stimulation of the ampulla of the right horizontal canal causes both eyes to turn to the left, the same movements as that which occurs when the animal is rotated to the right about its dorsoventral axis. Stimulation of the ampulla of the right anterior vertical canal causes the right eye to be elevated, the left eye to be depressed, and both eyes to roll backward on their axis; these movements are similar to those which occur when the animal is rotated head downward and to the right, that is, in the plane of the canal stimulated. When the ampulla of the posterior vertical canal is stimulated the right eye is elevated, the left eye is depressed and both eyes roll forward on their axes. These movements are identical with those which result from tilting the head upward and to the right, that is, a rotation in the plane of the posterior vertical canal. Of course, the stimulation of the symmetrically placed canals of the other side would merely transpose the use of the words left and right in this description. Ampullæ are exceedingly sensitive to mechanical stimulation. The results are absolutely clear and definite.

(b) *Extirpation*

On the basis of the above experiments Lee believed to have proof of the correctness of the Mach-Breuer assumption that the semicircular canals constitute the organ for the dynamic functions of the labyrinth. He attempted to put them out of function by cutting the ampullar nerves, or in some instances by destroying the ampullæ. He states that after cutting the nerves of all four vertical canals compensatory movements are wanting to all rotations in vertical planes, although compensation may be retained to rotation in a horizontal plane. Lyon (1899) on the other hand reported compensatory motions in response to all three rotations, after removal of all six ampullæ. I have developed a very simple and certain method of removal of the ampullæ, and I have repeated these experiments many times (1910, 1919) with the most complete regularity of results. I found that contrary to Lee's statement after removal of the ampullæ of the four vertical canals, or indeed of all six ampullæ, good compensatory movements occur to rotations around the longitudinal or transverse axis, but I have never yet seen the compensatory movements to rotation in the horizontal plane retained after removal of the ampullæ of the horizontal canals. Anyone who will take the trouble to repeat these experiments using my method will be able to see for himself that after loss of all the semicircular canals the labyrinth retains all its static functions, and all its dynamic functions except the response to rotation in a horizontal plane. The dynamic functions then are not confined to the semicircular canals.

II. THE OTOLITH ORGANS

(a) *Extirpation*

Experiments by removal of the otoliths have been carried on by many observers. Loeb (1891) found that scratching out the otoliths completely from the vestibule had much the same effect as section of the eighth

nerve. Lee (1893) reported that when the otoliths were removed from both ears compensatory movements were perhaps weakened but were not completely done away with; but that on the other hand the compensatory position was not retained after the movement ceased. Parker (1909) and I (1910) both found that the removal of the large otolith of the sacculus had no effect whatever on the equilibrium reactions, static or dynamic. Moreover I found that after removal of the otoliths from the sacculus and in addition all the six ampullæ good compensatory motions occurred to rotations in all planes except the horizontal if only the little otolith of the recessus utriculi remained uninjured. If now I removed the otolith of the recessus also every trace of labyrinthine reaction permanently disappeared. It made no difference in the result, however, if I omitted the removal of the saccular otolith.

The removal of the otolith from the recessus of the utricle without too great damage to the connection of the utriculus with the mouths of the anterior vertical and horizontal canals, especially the latter, was so great that at first it seemed impossible. In my earlier experiments I was puzzled by the fact after complete removal of the otolith the ampulla of the horizontal canal always ceased to function. When at last I was able to make a small incision through the delicate wall of the utriculus and wash out the otolith with a fine pipette I found not only that compensatory movements occurred in response to rotations in all planes, but that the compensatory positions were retained. Thus it becomes apparent that not only the otolith-organs without the ampullæ but also the ampullæ without the otolith-organs possess both dynamic and static functions. I may say here that in either case, after loss of the ampullæ or after loss of the otoliths, the reactions are noticeably slower and weaker than in the normal animal; evidently the two sets of structures reinforce each other.

(*b*) *Stimulation Experiments*

Stimulation experiments on the otolith-organs have been attempted by many observers but usually with inconstant, contradictory or negative results. Kubo (1906), however, reported very definite responses to stimulation by the application of pressure to the otolith. According to his statements the otoliths have definitely localized functions corresponding to those of the semicircular canals. These localizations corresponded to the statement of Breuer that the otoliths like the semicircular canals are arranged in three planes in space, each responding to motion in its own plane. Kubo states that the otolith of the utriculus when pushed anteriorly causes the eyes to roll backward, that is, to rotate on their axis, nasal pole up, which is the compensatory movement occurring when the head is tilted downward. Moving this otolith backward had no effect. In an analogous manner moving the large otolith of the sacculus backward gave the same movement as tilting the head up, and pushing the same otolith outwards from the median line gave the same reaction as that which comes from rotating the body to the same side around the longitudinal axis. In the light of our present knowledge Kubo's results are perfectly easy to understand, but are of absolutely no scientific value. His experiments were made without removing the ampullæ and he specifically states that they succeeded best when performed without removing "the membranous capsule of the gelatinous mass." In each case the result was just what would occur when he accidentally produced a change of tension on the nearest ampulla.

In order to study the effect of stimulation of any of the labyrinthine structures it is, of course, necessary to make sure that the structure in question is really the one in which the excitation takes place, since, as we have seen, all the compensatory movements which can be excited through the otolith organs in the absence of the semicircular canals can also be excited through the semicircular canals in the absence of the otolith organs. It is then evidently useless to attempt to determine the action of the otolith by stimulation experiments so long as the ampullæ of the canals are in place. The only completely

convincing demonstration of the otolith function is that which can be obtained in the absence of all other parts which could give the same reaction. This I have been able to accomplish in the most definite way (1920*b*).

My experiments on the otolith have been made on several species of sharks and rays. The most favorable animal for this purpose is the shovel-nosed ray or guitarfish, *Rhinobatus productus*. I removed all three semicircular canals with their ampullæ and then washed out the large, soft, friable otolith of the sacculus. There now remained only the small otolith of the recessus. This otolith is shaped somewhat like a plano-convex or concavo-convex lens and rests in a concave depression in which it fits much like one saucer standing in another. The concavity is lined with the characteristic macular epithelium with its hair cells. I found that if I pressed on the anterior side of this otolith the eyes rolled forward on their axes, *anterior pole* downward, that is, they made the same movement which occurs when the head is *tilted upward*. If I pressed on the hinder margin of the otolith the eyes rolled *backward* on their axes, the movement which occurs when the head is tilted downward. Pressure applied to the right margin of the otolith caused the *right eye to be depressed* and the left eye to be elevated, the same movement which results from rotating the animal to the *left* around its longitudinal axis, and this resulted whether the stimulus was applied to the otolith of the right or left ear. The method of stimulation just described very soon injured the delicate otolith and the movements could only be obtained a few times. When, however, I placed a small pellet of wet absorbent cotton on the otolith I could with fine forceps pull the pellet backward or forward or from side to side repeatedly without apparent injury to the otolith. When the cotton was pulled to the right the right eye went down, when pulled to the left the left eye went down, when pulled forward the eyes rolled forward on their axis, when pulled backward both eyes rolled backward.

The above experiment shows that the *a priori* assignment of different functions to different otoliths with reference to the planes in which they lie and the rotational movements of the body to which they correspond does not accord with the facts. All the compensatory movements and positions arising from vestibular stimulation are obtained from this otolith alone. Parker's and my previous observation that the large otolith of the sacculus is not concerned in equilibrium is confirmed. It is of interest, too, to note that the otolith of each ear gives rise to complementary movements in both directions; elevation of the right and depression of the left eye, or depression of the right eye and elevation of the left eye can be obtained from the otolith of either ear.

III. THE MECHANISM OF THE PHYSIOLOGICAL ACTION OF THE OTOLITH ORGANS

It has been almost universally believed since the publication of the earlier papers of Mach and Breuer that in the otolith organs the normal stimulus is the pressure due to the weight of the otolith resting on the sensitive macular epithelium; when the position of the head is changed the pressure is shifted to a different part of the macula and a different set of impulses is sent to the muscle groups concerned. This conception has been greatly strengthened by the work of Delage, Kreidl and others on the otocysts of invertebrates. But as I have shown in the preceding section stimulation experiments show with the utmost clearness and regularity results which are exactly the reverse of those which should follow if the pressure theory were true. In describing these experiments I have been repeatedly stopped to answer the question, "Don't you mean 'to the right' when you say 'to the left'?" or, "Don't you mean 'backwards' instead of 'forwards'?" When the normal animal is rotated around its longitudinal axis, to say 30° to the right, the right eye goes up and the left eye goes down. When the body is in this position the weight of the otolith in each ear must be shifted to the right. But when the right side of the otolith is pressed upon or when the cotton is

pulled to the right exactly the opposite movement of the eyes results. If as commonly believed, the stimulus is the pressure due to the weight of the otolith, and if that pressure, shifted to right by inclining the body to the right acts by stimulating more strongly the epithelium on the right hand side surely the artificial application of pressure should produce the same result but just the reverse actually happens. I believe that the actual process is as follows: When the right side of the otolith is pressed upon it is displaced to the left just as one saucer standing in another is displaced to the left when one pushes straight down on its right hand margin. This, then, is the same displacement as that which occurs when the body is tilted to the left. It is *not the pressure* but the *displacement* due to the weight of the otolith which brings about the normal stimulus. It is the *direction* of the *displacement* which determines the direction of the resulting compensatory movement. I have ventured to suggest that the displacement gives rise to differences of tension which act on the sensory structures in a manner analogous to the effects of different tensions on the vagus endings in the lungs. It will be seen in the following section that this wholly unexpected result is in accord with the conclusions which I had previously reached in regard to the mode of stimulation of the ampullæ.

IV. THE MECHANISM OF THE PHYSIOLOGICAL STIMULATION OF THE AMPULLÆ

An adequate discussion of the enormous literature of this subject would far exceed the limits of this paper. Nearly half a century ago Mach, Breuer and Brown almost simultaneously published papers suggesting that each canal functioned for the recognition of rotational movements in its own plane. Roughly stated the assumption was that rotation of the head in the plane of any canal would tend by the inertia of the fluid within the canal to produce a current in the direction opposite to that of the rotation. In the popular literature and in many of the text-books a favorite statement of the theory is about as follows: Each rotation of the head in the plane of any canal causes through the inertia of the endolymph a current in the canal in a direction counter to the rotation. The hair cells of the ampullæ stick out like paddles and are deflected in the direction of the current. The bending of the hair cells exerts pressure on the nerve endings and produces the stimulus. Mach, however, was too good a physicist to believe that a current could be produced under the conditions existing in the semicircular canals. He found that water placed in a glass model of the dimensions of a human semicircular canal showed no perceptible current when rotating at a reasonable speed. He affirmed on theoretical grounds that rotation could cause a pressure but denied the possibility of an actual current. Breuer (1899) also found on anatomical grounds that the theory in this form is not tenable, for the hair cells do not project into the endolymph, but are embedded in the gelatinous mass of substance forming the cupula. In more recent years Rossi (1914) has constructed a model of the dimensions of a human canal and has been able to demonstrate some movement of the contained liquid when rotated; but the rate of rotation necessary to produce visible movement is far beyond the order of magnitude of the rate giving a distinct physiological reaction. Moreover, according to the very beautiful anatomical work of A. A. Gray (1907–08) the semicircular canals in the squirrel and the rat have each a diameter only 1/5 as great as in man. These animals show no inferiority in labyrinthine reactions. In order to form a satisfactory demonstration it would be necessary to make the external diameter of the tube in the model 0.25 mm. I have found (1912) that in the horned lizard, *Phrynosoma,* rotation at an angular velocity so slow as a movement through 45° in 8 seconds caused a distinct labyrinthine reflex. Under these circumstances a current is unthinkable.

Direct experiment on the canals is more to the point than the foregoing theoretical considerations. Loeb (1891) cut through or excised portions of the canals in the dogfish

and found that no disturbance of righting reactions resulted. Ewald (1892) plugged and cut the canals in the pigeon without throwing them out of function.

I have ligatured, cut and plugged the canals in the dogfish (1910) without in the least disturbing their functions. But I have put the canal current theory to a more decisive test (1919). In the dogfish the compensatory movements to rotation in the horizontal plane are mediated only by the ampullæ of the horizontal canals, and each acts only for rotation toward its own side. If one horizontal ampulla, say the left, is removed, rotation to the right around the dorsoventral axis causes both eyes to deviate to the left, but rotation to the left has no effect. I exposed a right horizontal canal for nearly its whole length, cut it through as near as possible to its posterior connection with the vestibule, then without injuring its connection with its ampulla I raised it up and fixed it in the vertical plane at right angles to the longitudinal body axis. It is evident that with the canal in this new position rotation in a horizontal plane could not cause a current in its endolymph. But rotation to the right around the dorsoventral axis actually caused both eyes to deviate to the left, while rotation to the right (or left) around the longitudinal axis, that is in the plane of the new position of the canal, did not cause such a movement. It is evident that under the conditions of the experiment rotation in a horizontal plane could not possibly produce a current in the canal, and hence the stimulation must have been produced in some other way.

Since no further consideration need be given to the idea that the excitation on rotation is due to currents in the semicircular canals, we may briefly consider other possible causes. These might be effects due to (1) the inertia of the mass of fluid in the vestibule, or (2) due to the inertia of the ampullar contents, or (3) due to the inertia of the sensory cells themselves. The second and third of these possibilities are eliminated by the fact that when the membranous connection of the utriculus has been cut off the compensatory movements to rotation in the horizontal plane are entirely absent although the motions can be as easily elicited as ever by mechanical stimulation.

Since the transection of the utriculus abolishes the reflex it is clear that the utricular (and possibly the saccular) structures are an essential part of the mechanism. It is to be noted that the direction of rotation which acts as a stimulus to any canal is that which carries foremost the side of the ampulla bearing the crista. In looking over the large number of figures given by Retzius and by A. A. Gray I find no exception to this rule. The mouths of the canals at their ampullar ends are so connected with the vestibular parts of the membraneous labyrinth that the inertia effect of the mass of liquid (endolymph and perilymph) in the vestibule must cause an increase of tension on the part of the ampulla bearing the crista when a rotation is made in the direction in which the crista leads. A careful examination of the anatomical relations will show that even if it were possible for the inertia effect of rotation to cause a movement of liquid in the canal and thus exert a pressure on the cupula (the hair cells of course could not be acted upon directly), a much greater effect must be produced on the membranous structures in the vestibule. The relatively large mass of liquid in the vestibule with its proportionally small surface area exposed to the friction of the walls must show more inertia effect during rotation than the small amount of liquid in the canal with its proportionally large area of contact with the canal walls. The membranes which form the sacculus and utriculus are virtually stretched through the mass of liquid in the vestibule and must necessarily be put under tension when any rotational movement is given to the liquid.

If the above conception is the correct one it should be true that change of tension and not change of pressure should act as the stimulus. I had previously shown by experiments on *Phrynosoma* (1912) that the pressure due to centrifugal force has nothing to

do with the excitation. When the animal was placed with its head 25 mm. from the center of rotation it required no greater rate of rotation to act as a stimulus than when the head was 300 mm. from the center. The centrifugal force in the latter position is 12 times as great as in the former, but the angular velocity and hence the torsion effect was the same in the two positions.

Convection currents due to a difference in temperature on the two sides of the vestibule could much more conceivably occur in the liquid of the vestibule than in the canals. The nystagmus movements described by Högyes as a result of irrigating the external ear of man and many animals with hot or cold water and the change of character of the nystagmus by change of position of the head can best be accounted for by the changes of density of the liquid in the vestibule. The reliability of Bárány's use of these phenomena for diagnostic purposes is not affected by the acceptance of this view, but only his unscientific explanation must be abandoned.

I wish in closing to draw attention to the fact that a survey of all the experimental work on the labyrinth leads to the conclusion that the stimulation of the vestibular structures and of the sensory endings in the ampullæ depend upon the same principle, namely the effects of changes of relative tensions. How the change of tension excites the nerve endings and what part if any the hair cells play in the process still remains wholly outside the field of experimental investigation.

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MEETING OF THE GENETICISTS INTERESTED IN AGRICULTURE

IN conjunction with the meetings of the American Association for the Advancement of Science and affiliated societies in Chicago an informal gathering of instructors and investigators of genetics related to agriculture was held December 28th at the University of Chicago. Some thirty-five representatives from fifteen Agricultural Colleges and Experiment Stations, the United States Department of Agriculture and other institutions were present. Unfortunately the impossibility of getting the final notices out until very late prevented a number of others from attending. The purpose of the meeting was to discuss such topics of mutual interest at this time as

departmental organization, the place of genetics in the curriculum in agricultural colleges and cooperation in genetic investigations.

In order to open up the subject and start the discussion the above topics were assigned in advance by Professor L. J. Cole, of Wisconsin, who was largely instrumental in bringing about the meeting. In the carrying out of this plan Professors J. A. Detlefsen, Illinois, and R. A. Emerson, Cornell, spoke on organization. In their talks and the discussion which followed it was shown that in many institutions the instruction and research in genetics are scattered about in many different departments with no one person or department responsible for a fundamental course in genetics. In other institutions some genetics is taught in all departments with the emphasis laid in some one department, while in other institutions a separate department of genetics has been established which assumes all responsibility for genetics although other departments may give some special courses and carry on particular lines of research where the staff is interested and well fitted to do such work. All were agreed that a fundamental, general course of genetics should be required before taking up any applied courses in breeding, but in what department that course should be given is a secondary matter to be determined by existing conditions. Many thought it to be desirable for the teaching staff to keep in touch with applied problems of genetics by carrying on investigations of a practical nature although it would be unwise to limit either the theoretical or applied research to a single department of genetics as the outcome of such experiments depends so largely on familiarity with the material worked with and individual interest in particular problems.

In order to bring the general conclusions to the attention of the authorities of the agricultural colleges and experiment stations a committee was appointed to draw up a statement which would embody in a general way the consensus of opinion of this meeting in regard to the matter of departmental organizations. The following resolution was prepared and adopted:

> As far as consistent with present organization in agricultural colleges a single department of genetics, prepared to handle the elementary and advanced courses of general genetics and to direct the investigational work on the basic principles of genetics, has certain practical advantages in that such an arrangement: (1) simplifies administration and prevents unnecessary duplication; (2) identifies and gives standing to the subject of genetics in the curriculum; and (3) unifies instruction and research. Such a department should not attempt to control all the investigational work in specialized subjects on either the applied or theoretical problems of genetics but would be able to cooperate in every way possible to advance the outcome of such investigations.

The place of genetics in the agricultural curriculum was discussed by Professors E. B. Babcock, California, and S. A. Beach, Iowa. In their presentations and in the discussion which followed it was stated that it is theoretically desirable that a general course in genetics should be required of all students of agriculture but that in practise it is not always possible to do this. Most institutions require genetics of students taking certain courses, particularly those concerned directly with plant and animal production. In other institutions genetics is optional with the student or left to the student advisers. Laboratory work is not always required except of those students who intend to specialize in genetics. A general course in genetics should come as early in the curriculum as possible, usually in the second or third year, and should follow an elementary course in biology or its equivalent and precede any of the courses in applied genetics. This would seem to be self-evident but as now practised this is not always the case. There should, furthermore, be only one such elementary course, in whatever department given, which should treat of the general principles and lay the foundation for further application to special subjects.

The subject of cooperation in genetic investigation was discussed by Professor M. J.

Dorsey, Minnesota, who emphasized the close relationship of genetic investigations on applied problems with other sciences, cooperation being particularly necessary to secure the greatest results. All who entered the discussion of this topic thought that cooperation should not go on so far as to attempt to direct another's research and that the success of any cooperation of this kind is limited by the mutual confidence of the workers.

At the close of the meeting it was agreed that no permanent organization should be formed but that informal meetings such as this should be arranged for whenever desirable. Professor L. J. Cole, who was elected chairman of the meeting, was voted to act as secretary *ad interim*. D. F. Jones,
Secretary pro tem.

NATIONAL PARKS[1]

While a small number of scientific societies were represented, the conference was well attended, especially by those interested in natural parks for recreation purposes. Their aim is to secure more parks and protect existing ones. Very few of the existing parks and preserves are free from liability to extensive modification through recreation activities, scientific forestry, fires, or exploitation. Even the National Parks must be watched and defended against external aggression. There are now only a few areas aside from the National Parks which have been set aside with the intention that they should be left in a natural state. Most areas have been and probably will continue to be set aside primarily as recreation parks, or as forest preserves. The main business of those interested in areas to be held in an original state, must of necessity be to get areas set aside within these forest preserves and parks.

The following was made evident by the conference.

[1] Report of the delegate of the American Society of Zoölogists to the National Conference on Parks, Des Moines, Iowa, January 10–12, 1921. This report will be submitted to the American Society of Zoologists at their next annual meeting. —W. C. Allee, *Secretary-Treasurer.*

1. That the forces interested in the establishment of natural parks and forest preserves for recreation purposes—to make "better citizens through contact with nature" are well organized, and are probably the strongest force operating to secure more parks and protect existing ones.

2. Science has left them quite uninformed of its needs for natural areas and of the practical significance of scientific results which may accrue from study of natural areas. They welcome the idea of biological study as a further argument for natural tracts.

3. They are, however, without constructive plans of management of the smaller tracts which will insure them against destruction from over use as recreation parks. Such plans of management must be based on knowledge of plant and animal ecology which they do not possess.

4. They are engaged in drafting legislation and in advising legislators without the counsel of those interested in preserves for research purposes.

5. It is incumbent upon scientific societies, museums, and universities to organize and to provide funds which will serve the following purposes: (*a*) to place information as to the scientific uses, and scientific management of natural areas, into the hands of those individuals and organizations working for the preservation of natural conditions; (*b*) to make possible the representation of scientific needs before legislative bodies and officials; (*c*) to provide for furthering the wise selection of new areas, and (*d*) to make existing areas accessible to scientists by the publication of lists and guide books.

V. E. Shelford

SCIENTIFIC EVENTS

WORLD PRODUCTION OF COAL IN 1920

Reports received by the United States Geological Survey indicate that the total output in 1920 was about 1,300,000,000 metric tons. This, although a great increase over 1919, was still 42,000,000 tons short of the output in 1913, the last year before the Great War. The

course of production during the last decade is shown in the following table. The unit of measurement, it will be noted, is the metric ton, which will be most easily remembered by American readers as roughly equivalent to the gross ton of 2,240 pounds. The fluctuations in world coal supply, if expressed as index numbers, taking the output in the year 1913 as equal to 100, become as follows:

1910	86	1916	97
1911	89	1917	100
1912	93	1918	99
1913	100	1919	86
1914	90	1920	97
1915	89		

These figures are necessarily in part estimated, for official statistics are slow in coming in and for certain countries of eastern Europe—notably Russia—even unofficial data are lacking. The figures are presented as tentative and subject to revision. As official reports are available for 92 per cent. of the world's output, the margin of error in the total probably does not exceed 1 or 2 per cent.

In comparing the 1920 output with that of the years before the war it must be remembered that the world's consumption of coal normally increases by leaps and bounds. The average rate of increase in the 20-year period preceding August, 1914, was 38,000,000 tons. Of course the waste and disorganization of the war have reduced the consuming capacity of many countries, but in other countries, notably the United States, requirements have been increasing at a rate greater if anything than before the war.

The present rate of production in the world is the resultant of conflicting forces; the decline in the war-torn countries is being offset in part by an increase in regions remote from the battlefields. In the belligerent countries of Europe the war cut heavily into production. Sometimes the cause of the decline was physical destruction of the mines, as in France; sometimes it was the drain upon the man-power of the nation; sometimes it was merely the economic disorganization and disruption of normal trade which attended the war. In France the 1920 output (excluding the Saar and Alsace-Lorraine) was 46 per cent. less than that of 1913; in Great Britain the decline was 20 per cent.; in Germany (also excluding the Saar and Alsace-Lorraine) the output of bituminous coal decreased 24 per cent., a decrease which was in part, however, offset by the increased production of lignite. In eastern Europe the old Austro-Hungarian empire, Russia and the Balkans, the breakdown caused by the war was even greater than in western Europe, and the decline in output proportionately large. Of all the major European belligerents only Belgium had in 1920 practically reattained the pre-war rate of production.

While in 1913 Europe led all the continents as a producer of coal, contributing 54 per cent. of the world's output, in 1920 she had yielded first place to North America and her share of the world's total had shrunk to 46 per cent. The largest factor in filling the void caused by the war in Europe was, of course, the United States. Our production increased from 38.5 per cent. of the total for the world, in 1913, to 45.1 per cent. in 1920. In that year our seaborne exports of coal were 22,500 net tons, five times what they were in 1913.

TOP MINNOWS AS YELLOW FEVER ERADICATORS

According to *The Fisheries Service Bulletin* the success which has attended the use of the top minnow (*Gambusia*) in eradicating malarial mosquitoes in various parts of the United States has led to the employment of the same fish in combating an incipient epidemic of yellow fever at Tampico, Mexico.

Dr. A. R. Stubbs, of the Standard Oil Co., who visited the Washington office in March, reported that cases of yellow fever appeared at Tampico during the past summer, and there was every indication of a serious epidemic, as the conditions for the spread of the disease among the natives were most favorable. In addition to numerous outlying ponds, pools, sloughs, and marshes in which mosquitoes breed, all of the native houses have open barrels or other receptacles con-

taining rain water that is used for domestic purposes and is the only supply of fresh water that the natives possess.

At the outset the oil interests organized an antimosquito campaign, conducted through a committee headed by Dr. Stubbs. About 600 men were constantly employed in oiling the ponds and other open waters, and also the receptacles in which the natives keep their water for domestic purposes. The use of crude oil on the water required by the natives for drinking and cooking naturally caused much dissatisfaction.

After some months, when an official of the U. S. Public Health Service visited Tampico, he mentioned the value of *Gambusia* in the antimosquito work of the Public Health Service and Bureau of Fisheries, and suggested that this fish might be available for the yellow-fever campaign at Tampico. A search was forthwith made and *Gambusia* was found in abundance in the vicinity. Since December 1 the top minnow has entirely replaced crude oil as an eradicator of mosquito larvæ, the natives are much pleased at the change, and the reduction in the expense has amounted to $3,000 weekly.

THE NATIONAL BOTANIC GARDEN[1]

Five years ago the commission of fine arts was requested to investigate and report as to the possibilities of relocating the existing Botanic Garden, at the foot of the Capitol, from its present restricted area to a more suitable site, and after surveying carefully several suggested sites in the District of Columbia decided upon Mount Hamilton and the land adjacent as the most suitable location for a National Botanic Garden. A year ago at a hearing before the joint congressional committee on the Library the plan was again thoroughly discussed. The highest scientific and botanical authorities in the country attended the hearings, and not only indorsed the site as being in location, area, variety of soil, elevation and accessibilty most adaptable for a National Botanic Garden, but asserted also the great need for such a garden as would be comparable with those of other great countries of the world.

[1] From *The Washington Post.*

Once the National Botanic Garden has been established and developed, it would be one of the great sightseeing places of Washington, which would be visited by thousands of persons annually. The Zoological park is 3.50 miles and Arlington National Cemetery 4.50 miles from the Capitol, yet each is visited by thousands of persons each week. The daily average attendance at the Zoological Park is 6,108, from 20,000 to 40,000 on Sundays and more than 2,000,000 for the year. The Mount Hamilton site is only two miles northeast of the Capitol, and is accessible by lines of street cars. In addition the National Botanic Garden would be a place where thousands of school children of the city could make a study of plant life and the garden would continually be a place of enjoyment for residents of the city. The Mount Hamilton site is on the main highway between Baltimore and Washington, one of the main approaches of the city. A boulevard would lead through the grounds along which a countless number of persons would travel each year in order to see the garden.

MEDICAL PRIZES

The *Journal* of the American Medical Association announces the following prizes:

The Mörsel Foundation offers a prize of 10,000 marks for the best work on the etiology, diagnosis or treatment of cancer, representing important progress. A second prize of half the amount will be given for the second best work. Competition is open till October 1, 1922. Competing articles are to be sent to the director of the Institute for Experimental Cancer Research at Heidelberg. The competing works must be in German and must have been published between January 1, 1921, and October 1, 1922, or be ready for publication when presented.

The Royal College of Physicians of Edinburgh announces the Parkin Prize of £100, open to competitors of all nations, for the best essay "On the Effect of Volcanic Action in the Production of Epidemic Diseases in the

Animal and in the Vegetable Creation, and in the production of Hurricanes and Abnormal Atmospheric Vicissitudes." Particulars regarding the conditions of the contest may be secured from the secretary, Dr. J. S. Fowler, Edinburgh.

In honor of Dr. Charles Lester Leonard who died in 1913 a martyr to research with the roentgen ray, the American Roentgen Ray Society offers a $1,000 prize for the best piece of original research in the field of roentgen ray, radium or radioactivity. The competition is open to any one living in the United States, or its possessions, Canada, Mexico, Central and South America and Cuba. The research work must be submitted in writing in the English language not later than July 1. The winner will read his paper at the annual meeting of the society in September. Dr. Henry K. Pancoast of the University Hospital is a member of the committee in charge of the competition.

THE COMMITTEE ON PHYSIOLOGICAL OPTICS OF THE NATIONAL RESEARCH COUNCIL

Under the auspices of the Division of Physical Sciences of the National Research Council, there has recently been formed a Committee on Physiological Optics consisting of

Professor Adelbert Ames, Dartmouth College,
Professor W. T. Bovie, Harvard University,
Dr. P. W. Cobb, Nela Research Laboratory,
Mr. L. A. Jones, Eastman Kodak Company,
Dr. W. B. Lancaster, Boston,
Dr. P. G. Nutting, Pittsburgh,
Dr. I. G. Priest, Bureau of Standards,
Professor J. P. C. Southall, Columbia University,
Dr. L. T. Troland, Emerson Hall, Harvard University, Cambridge, Mass.,
Professor F. K. Richtmyer, Cornell University, Chairman.

This committee recently held a meeting in New York for the purpose of organization and discussion of the problems before it. The diversity of present theories of vision was thought to be due in large part to the circumstance that the workers in the sciences contributory to visual phenomena, such as physics, physiology and psychology, seldom, if ever, get together to talk over problems of mutual interest and to get each other's viewpoint.

To facilitate an interchange of ideas among the various groups of workers, the committee voted to request the Optical Society of America to form a Section on Vision. Such a section has been authorized by the society and the first meeting will be held in Rochester in October, 1921. It is hoped that all those interested in the pure or applied science of vision, such as physicists, physiologists, psychologists, ophthalmologists, photochemists, illuminating engineers, etc., will join the new section and will take an active part in its work.

The committee will also immediately make a survey of present research in progress. Later will be issued a report on the present status of physiological optics with some outstanding problems for research.

SCIENTIFIC NOTES AND NEWS

At the annual dinner of the National Academy of Sciences on April 26, the following medals were presented: To Dr. Charles D. Walcott, secretary of the Smithsonian Institution and president of the Academy, the first award of the Mary Clark Thompson Medal for distinguished achievement in geology and paleontology. To Albert I., Prince of Monaco, the Alexander Agassiz Gold Medal for contributions to the science of oceanography; to Dr. P. Zeeman, of Amsterdam, Holland, the Henry Draper Gold Medal for eminence in investigations in astronomical physics; to Rear Admiral C. D. Sigsbee, U. S. N., retired, the Agassiz Gold Medal, the same as the medal to the Prince but awarded one year later, for eminence in investigations in oceanography; to Dr. Robert Ridgway, the Daniel Giraud Elliot Gold Medal for his studies of the birds of North America, and especially in recognition of Part 8 of his "Birds of North and Middle America"; to Dr. C. W. Stiles, the Gold Medal for eminence in the application of science to the public welfare, in recognition of his work on the hook worm disease.

THE June issue of the *Medical Review of Reviews* will be a special radium number, dedicated to Mme. Curie. The issue will consist exclusively of articles on radium and its uses.

As Professor A. Netter of the University of Paris soon reaches the retirement age, his friends and pupils are planning to present him with a testimonial plate.

EIGHT professors of the College of Agriculture of Cornell University will be on sabbatic leave next year. They are Professors Herbert H. Whetzel, George W. Cavanaugh, Ralph S. Hosmer, Karl M. Wiegand, Arthur B. Recknagle, Blanche Hazard, Anna B. Comstock and Earl W. Benjamin. Professor Whetzel will organize a plant pathology service for the Bermuda Islands. Professor Hosmer will make a study of the forests of England, France, Switzerland, Sweden and Norway. Dr. Benjamin will act as general manager of a poultry-producing firm in New Jersey, making efficiency and cost studies.

THE department of medical zoology of the school of hygiene and public health of the Johns Hopkins University has recently arranged to send during the summer of 1921 an expedition to Porto Rico for the purpose of studying the malaria problem and other problems involving disease-producing protozoa and their vectors. Dr. R. W. Hegner will devote his time especially to the study of the malarial organism and other blood-inhabiting protozoa and to the intestinal protozoa, and Dr. F. M. Root, who will accompany him, will make a survey of the mosquitoes, fleas and other distributors of pathogenic microorganisms.

WALTER L. HOWARD, professor of pomology in the University of California, now in charge of the new Deciduous Fruit Experiment Station at Mountain View, California, has been granted a year's leave of absence to make a study of root stocks for deciduous fruits. Accompanied by his family, he will sail from New York to Europe on June 25, going direct to Angers, France. The field of study will include France, Italy, Spain and England.

UNDER the auspices of the General Electric Company and Union College, Professor F. K. Richtmyer, of the Department of Physics at Cornell University, has given in Schenectady, during the present academic year, a course of lectures on modern physical theories.

ON April 7, Professor Edward Kasner, of Columbia University, lectured on "Einstein's theory of gravitation" at the College of the City of New York. Professor Einstein attended and took part in the discussion.

DR. GEORGE H. PARKER, head of the department of zoology at Harvard University, is in residence at Pomona College as Harvard exchange professor, from April 11 to May 6, giving two courses of lectures, on "The origin of the nervous system" and "Smell, taste and allied senses."

PROFESSOR HARRIS J. RYAN, of Leland Stanford Junior University, spoke on April 20 before the Physics Club of the California Institute of Technology and the Mount Wilson Observatory on: "High voltage phenomena encountered in the study of the insulation requirements for the proposed 220,000 volt power transmission lines."

ON April 23 Dr. Dayton C. Miller, head of the department of physics, Case School of Applied Science, and secretary of the American Physical Society, gave an experimental lecture upon "Photographing and analyzing sound waves."

DR. HARVEY R. GAYLORD, director of the New York State Institute for Research in Malignant Diseases, and Dr. Charles Cary, of Buffalo, left for Germany on April 23 to investigate methods developed in Germany for applying X-rays to cancer.

JAMES ZETEK, formerly entomologist to the Panama Canal, has been appointed specialist in tropical insects with the Federal Horticultural Board, U. S. D. A., in charge of the temporary field station at Ancon, Canal Zone, Panama.

DR. PAUL E. KLOPSTEG, who has been connected with the sales and advertising department of Leeds and Northrup for several years,

has recently accepted a position with the Central Scientific Company of Chicago as manager of development and manufacturing.

Professor James H. Leuba, of Bryn Mawr College, who is to be abroad during the next academic year on sabbatical leave, has been invited to give five lectures at the Sorbonne in the Fall of 1921, under the auspices of the Institut de Psychologie. His subject will be the psychology of religious mysticism. He is also to deliver a series of lectures at Kings College, London.

The Columbia Chapter of the Society of Sigma Xi announces a lecture on "Progress in physics in the last decade," by Michael Idvorsky Pupin, professor of electro-mechanics. This lecture which was given on the evening of May 4 is the first of a proposed series of annual lectures on the Progress of Science.

An address on "The spirit and method of research in agriculture" was given by Dr. E. W. Allen, of the office of experiment stations, at the college of agriculture, at the Ohio State University, on April 15.

Dr. Arthur Gordon Webster, head of the department of physics at Clark University, will sail on May 28 for London, where he will deliver a lecture on "Researches on Sound," before the Royal Institution, on June 10.

Dr. Frank Schlesinger, director of the Yale Observatory, will deliver an address before the Yale chapter of Sigma Xi on "The distances of the stars," on May 10.

Dr. C. G. Abbot, assistant secretary of the Smithsonian Institution, delivered an address before the Washington Academy of Sciences on April 22 on "The solar constant observing stations of the Smithsonian Institution."

Dr. George Frederick Wright, known for his contributions to geology especially glacial period, and professor emeritus of the harmony of science and religion at Oberlin College, died at Oberlin on April 20, aged eighty-three years.

The establishment of the Chemical Warfare Service at Edgewood Arsenal, Edgewood, Maryland, will appoint fifty chemists as soon as suitable men can be secured. The United States Civil Service Commission has announced that until further notice it will receive applications for these positions in the following grades: Chemist at $3,000 to $5,000 a year, associate chemist at $2,000 to $3,000 a year, and junior chemist at $1,400 to $2,000 a year. Promotion from the lower to the higher grades will depend upon demonstrated ability and the needs of the service. The examination announcement states that there are opportunities for employment in fifteen specialties of chemical science. Full information and application blanks may be obtained by communicating with the United States Civil Service Commission, Washington, D. C.

The inadequacy of the appropriation to the Bureau of Fisheries for scientific work has made necessary a reduction in the number of projects to be pursued by that bureau during the next fiscal year and will necessitate keeping the Woods Hole, Massachusetts, laboratory closed during the summer. Therefore, no applications for the use of tables during the coming season can be approved.

A communication from J. Parke Channing of New York, chairman of the American Engineering Council's Committee on Public Affairs, has been placed before President Harding and representatives of the council have been advised that the president is considering the recommendation that an engineer be placed on the Interstate Commerce Commission with other recommendations for appointments to the three vacancies. A supplementary communication was also submitted to the president naming six engineers with qualifications for this appointment in the hope that such list would be useful to him. In representations to the president, the council is also acting for the American Society of Civil Engineers, the American Association of Engineers and the American Institute of Consulting Engineers. The American Engineering Council's Committee on Procedure has appointed L. W. Wallace, executive secretary of the council, as its representative on the U. S.

Board of Surveys and Maps. Mr. Wallace succeeds Alfred D. Flinn, secretary of Engineering Foundation, and has been assigned to the Committee on Cooperation. Members of the Advisory Council of the board have been urging the American Engineering Council to aid them in obtaining an adequate program involving a larger appropriation for topographic maps. Congress has asked for an outline of this program and as soon as this is completed the council will decide on the support that can be given.

The prospect of large lumber operations in South America carried on by interests from the United States is opening a field of promising possibilities to the American forester, and this situation has caused the faculty of the New York State College of Forestry to consider the advisability of adding Spanish to the language requirements of the forestry course. The value of Spanish to the American forester is a reflection of the growing scarcity of forests in the United States and Canada. The consequential high prices of wood products make lumbering in distant countries profitable. South America, according to authorities of the college, presents a new sphere of discovery in wood utilization as there are many species of trees about which little is known regarding their applicability to commercial purposes. The pine forests of Chili and southern Brazil occupy vast areas. The Brazilian Parana pines are said to cover 260 million acres and will produce from five to ten thousand board feet per acre. Restrictive export duties and the lack of shipping facilities have prevented earlier exploitation of these natural resources of South America, but the prodigality of the United States in the use of its forests has overcome these obstacles.

UNIVERSITY AND EDUCATIONAL NOTES

The College of Agriculture and the College of Veterinary Medicine of Cornell University will receive approximately $1,350,000 from the State as a consequence of the appropriation bill signed by Governor Miller. The College of Agriculture will receive, roughly, $1,250,000, while the Veterinary College, it is estimated, will receive $100,000, which is slightly less than last year's appropriation.

The North Carolina Legislature has granted the University of North Carolina $925,000 as a two-year maintenance fund and $1,490,000 for permanent improvements for two years.

Professor George C. Embody has returned to Cornell after spending the period since last September establishing at the University of Washington the first college of fisheries in an American university.

Dr. Ira M. Hawley, of Cornell University, has been appointed professor of zoology and entomology at the Utah Agricultural College and Entomologist for the Utah Agricultural Experiment Station. Sherwin Maeser, Ph.D., University of California, has been appointed associate professor of chemistry at the college.

Dr. Lewis Knudson, of the department of botany of Cornell University, has gone to Spain to assist in establishing departments of plant physiology in the Universities of Madrid and Barcelona.

DISCUSSION AND CORRESPONDENCE

PALEOBOTANY AS VIEWED BY TWO GEOLOGISTS

In the current April *American Journal of Science* appear two papers reciting the larger stratigraphic and faunal evidence bearing on climate in time. Professor A. C. Coleman in the first of these lectures cites especially Dr. Knowlton's views of all-tropic ancient climates thus:

> Part I. of Dr. Knowlton's paper rouses enthusiasm with its splendid array of forests mostly tropical from all parts of the world culminating in the Eocene flora. His account of the vegetation of the past confirms and heightens the impression left by paleozoology that during the greater part of the world's history temperatures have been genial even in the far north and far south where

frigid climates now reign. Annual rings are rarely found in the trees, and only once before the Pleistocene is a period of severe cold admitted in the early Permian time of glaciation; and then the cold period was "probably of short duration," and did not affect North America, Europe or northern Asia.

It is further observed that while few references to periods of cold or drought in the world's history are found in paleobotany, "mild and moist periods are tremendously emphasized," and intervening periods of drought and cold "slurred over, or entirely unrecorded."

It is not surprising, then, that the evidence for aridity and cold during several periods of the earth's history should make little impression on a paleobotanist!

In somewhat similar inference or vein, Professor Charles Schuchert follows with several pages on climatic evolution. To Coleman's brief consideration of the more readable phases in the evidence for desert conditions seasonal variations, and ice ages in the past, Schuchert adds the Blackwelder view that a study of the color phases and stratification of the Alaskan sedimentary series indicates a more or less persistently cool moist climate throughout the known geologic history of Alaska. And the more or less provable fact is emphasized that there is usually "a dearth of plant evidence for the climatic conditions during the early and late parts of the many periods when the continents were largest, highest and most arid."

For several years I have called attention to the remarkable series of Rhätic plant localities in Argentina which strongly suggest a climate like that of to-day. And too, the shales in which these plants occur are highly laminated [seasonally so]. But in such instances, which may be depended upon to multiply, the paleobotanist must yet find the fuller means of proving the presumption of cold and aridity from plant types, however insistently others may ask immediately coordinated proof. Similarly it was stated in SCIENCE several years ago that:

There is a very small record of the upland vegetation of past times; although the enormous extent of the unknown upland record could not be surmised so long as the alternate emergence and subsidence of the continental areas remained wholly unmapped. Yet it appears that the high upland and polar, and not the tropic or coastal fringe plants have long included the great majority of plastic forms; and it is certain that upland and polar forms moved forward during the periods of continental emergence closing the geologic epochs, and were least liable to extinction during medial subsidence. That is to say we know best the aplastic coastal fringe forms with a broken record.

Again it was stated (Vol. II., p. 238, American Fossil Cycads):

Almost invariably from the Devonian on, it has been mainly xerophyllous lacustrine or swamp types which form the great bulk of fossil plants. Even the 3,000 species of Carboniferous time afford only a one-sided picture of the specialized coal swamp floras; no glimpse is had of contemporary mountain or upland florules.

Furthermore the notion that the tepid climates of the older botanists and zoologists have no basis (Berry), and are not sustained by the long studied invertebrate record, only finds a more insistent expression in recent text books. It goes back to Leopold von Buch, and received elaboration by Neumayr. It finds so far as elements go mention in Dana. It was stated to me in pretty hard and fast form in the field as a beginning student, by an old teacher, A. von Könen, twenty-eight years ago. And any one who takes the trouble to read a contribution I brought out in 1903, on the rôle of polar climates in evolution, then a sort of philosophic study, can well understand that the ideas of the real character of sediments and the indicators of seasonal change which are quite in entirety of more recent date, would have been "old grist" for the polar mill.

As a main objective, let me try to explain in a few brief paragraphs for the sake of both botanists and geologists the nature of the paleobotanic crux.

Primarily the Cretaceous floras looked tropical, and it has been difficult to read anything else into them. If it can be done it will require long and elaborate quantitative study of the phytologic factors. It would however be early to say there are no cold scrub forests in the lower Cretaceous, and I give some attention to this subject in the current April number of the *American Journal of Botany*. Then at the other end of a long record stood juxtaposed the dank coastal fringes of coal plants; whence the long series of the Permian, Triassic and Jurassic, found their more obvious antecedents in warm climates and seemed to terminate in such. The ginkgos were long almost the only element suggesting interruption to the all-tropic landscape, with the fact that they must be a very great phylum, hidden. But with the cycads dominant and certainly tropical, there was no *open sesame* to a broader vista for the paleobotanist.

Now it was at this point that Nathorst and Wieland, using the words of the excellent University of Glasgow historian of botany, "began to learn something about the cycads." It was found that these had flowers with the possibility of all the sex variation seen in dicotyls, and stems with generalized structure. A great Cycadophyte leaf series was discerned resting under more than a suspicion of affinity to the forerunners of the angiosperms. And presently it was found that the cycadeoid types were in great numbers microphyllous, and that they crossed over into small fern-like leaves called *Tæniopteris*, etc. Next the paleobotanists seemed as if by common consent to see side by side with the ever lengthening cycadeoid record a great ginkgoid phylum. Within but a few fortunate years of investigation types of scrub, for such many of the cycadeoids surely are, and forest elements with the capacity to live in varied climates, could be pointed out with some degree of safety.

But as a bare half dozen invertebrates can not firmly set the age of the "Cannonball shales," limited series of animals and of plants of unfixed affinity, can make neither a summer nor a winter. And so the difficulties which beset the work on fossil plants must be met serially.

Meanwhile as paleobotanists we are peculiarly indebted to Dr. Knowlton for his splendid Philippic on tropic climates. It was well that it should appear in this time of rapid accumulation of new facts, at least as a warning against the grave danger of an overburden of inference in the guise of proven fact. Even that big and valuable word *diastrophism* might suffer. And the aggrading of the continents, with their reappearance, mountain bulwarked as regularly as Chladni figures, might fail of demonstration. The Knowlton defense has already functioned in bringing out the two accentuations of the value of the physical and paleozoologic factors herein noted. Yet, the lower-most Cretaceous floras of the mid-west are not truly tropic. We may doubt if there is a single North American dicotyledonous flora, unless it be that associated with the Vicksburg Oligocene, that by any possibility merits the term tropical in a strict sense. "Many of the floras indicate warmer or wetter conditions than now prevail in correspondent latitudes; but most are far from tropical."

All evidence must eventually be coordinated, and the paleobotanists will lay ears to the rocks. To use exactly the witticism of Voltaire, let our *conchiferous* brethren be reassured.

G. R. Wieland

HAVE BIRDS AN ACUTE SENSE OF SOUND LOCATION?

There can be little doubt that the drum membrane picks up very minute energies in the form of sound vibrations. There can be no question that a certain amount of the energy impinging on the outer surface of the drum membrane passes through it into the air of a cavum tympani. It may also be conceded that energies entering the middle ear area are fairly well dampened out in so far as a reflection back toward the drum membrane is concerned. This is true for the mammals. The bird, however, has but a single middle ear

which is flanked on either side by a drum membrane. The energies transmitted to the air of the middle ear from the deep surface of one drum membrane may pass directly to the deep surface of the other membrane.

The ability to locate a sound may be partly due to its intensity. It may also be due to a differential registration of fundamental and overtones on the two sides. A pure tone may not be located. Overtones are less readily dampened out than fundamentals as Mach's experiments seem to indicate. The relation of the position of the sound source to the head-form and diffraction into the two external canals would therefore play an important rôle in relation to the differential registration of fundamental and overtones. This was I believe worked out in part by Fite of Princeton University.

It would seem that the evidence in birds points not only to a great acuteness in hearing but also to a definite ability in determining the direction of the sound source. This in spite of the fact that birds do not possess the functional auricle of the mammal. If it be true that the sense of location for sound is so well developed in owls, woodpeckers and possibly robins, then a special significance may be attached to a confluence of the middle ear cavities. It may be that a more definite analysis of the fundamental and its overtones is due to a greater efficiency of the two drum membranes applied to a single middle ear.

The writer will appreciate and acknowledge any direct observational data on this problem of the acuteness of hearing in birds and in particular the evidence for the definiteness with which a bird may locate a sound source.

A. G. Pohlman

St. Louis University School of Medicine

QUOTATIONS

SCIENTIFIC ORGANIZATION

Professor W. M. Wheeler, a learned and witty American biologist, has recently addressed a genial remonstrance to his scientific fellow-citizens on their devotion to resounding phrases. His remarks deserve a wider application, and are very pertinent to ourselves. The current watchword of the elect, he says, the "highbrow" toast of the moment, is "organization." Wayward, individual pursuit of knowledge is out of fashion. It is distasteful to the bureaucratic spirit of the age, it tends to overlapping of effort, and it exalts personal reputations, possibly and regrettably those of obscure unofficial people. The committee is the thing. The problem must be set, the parts allotted, the results received, edited, and issued by the authority of men sitting round a table. There must be sub-committees and super-committees, joint committees and special committees. How else shall we control genius, encourage mediocrity, and secure "team-work"? How better can science present a respectable front to governments or offer responsible hands for grants-in-aid? A detached individual is an unstable creature; he may die, neglect to report, get off the lines, or make discoveries of a very upsetting kind. A committee is safe; its existence secures continuity and is a guarantee against the precipitate production of uncomfortable truths. But the professor fears that the child product of organization is organizers, and that in elaborating our machinery we forget its purpose. Fortunately, however, mankind is wiser than any of its generations and has a knack of creeping out of the hard shells it continues to secrete. "Organization" is the fad of to-day, and will be as ephemeral as its predecessors. "Culture" was one of these. But "culture" died, and its corrupt body became decadence when, ceasing to be a mental attitude, it became an intonation and a set of opinions. Progress was another; but that has hardly recovered from the shock of the war, which gave us good reason to distrust some aspects of modern civilization. Now even popular preachers find it safe to mock at "progress." The truth is that a conception seldom becomes crystallized in a phrase until it has outgrown its most fertilizing activity. Ideas have their cycle of life; they are born of the great, named by the dull, and killed by common usage.—The London *Times*.

In his presidential address (printed in SCIENCE for January 21 last) before the Zoological Section of the American Association for the Advancement of Science at its Chicago meeting Professor W. M. Wheeler discussed the subject of organization in research as it appears to a biologist, and pointed out some of the dangers attending post-war efforts in this direction. He mentioned the array of instincts, emotions, and interests on which the activities of the investigator depend and the great diversity of mental aptitude which necessarily accompanies the genius for different types of research. Professor Wheeler claims that any organization dealing with research should refrain carefully from interfering in any degree with the free expression of the individual's exceptional aptitudes in his own way. In these days when the amateur in scientific research is passing we need to beware of fettering in any way by government or other interference the activities of the professional scientific man.—*Nature*.

SCIENTIFIC BOOKS

Catalogue of the Coleoptera of America North of Mexico. By CHARLES W. LENG. Published by John D. Sherman, Jr., Mount Vernon, N. Y., 1920. Pp. 470; large octavo.

I don't know how many collectors and students of Coleoptera there may be in the United States—certainly not so many as in several of the European countries, and they are probably not as numerous as the collectors of Lepidoptera. But their numbers will surely increase, and the labors of the present students will be greatly facilitated by the appearance of Mr. Leng's long-expected and thoroughly admirable catalogue.

A good, up-to-date catalogue is a tremendous help and stimulus. The Coleoptera of North America have not been comprehensively listed since the American Entomological Society published Henshaw's list in 1885, more than 35 years ago, and in the meantime large groups have been comprehensively monographed, the scheme of classification has been modified in important particulars, and the names of genera and families have been changed, while the number of described species has increased from a little over nine thousand to a little less than nineteen thousand.

As a result of the publication of this catalogue, the American Coleopterists for the first time in many years know for the moment just where they stand. And what a joy it must be to them! And what a relief it is to all general entomologists! I can imagine the veteran, Samuel Henshaw, himself, sitting in the Director's Office of the M. C. *Z.* at Cambridge, heaving a deep sigh of satisfaction and saying to himself, "Good! My New England conscience is at rest. What I looked forward to years ago is done, and excellently done."

There are catalogues and catalogues. The best ones are more than mere lists, but none the less are based absolutely on the literature and do not reflect too much the individual views of the specialist author. Such is the great synonymical Catalogue of the Coleoptera of the World by Gemminger & Harold, and such is the present catalogue of which we write. Its publication is an event! It is a great big stepping stone!

One like the writer, who knows the Coleoptera only in a general way, is first of all impressed by the excellent make-up of the catalogue. It is printed upon excellent paper; and it can be obtained from the publishers in a very good binding. The topography is of a high character. These, however, while worthy of especial note, are only adjuncts to the main appreciation.

One who is not familiar with the enormous amount of work which has been done by clever men of many countries, will not in the least appreciate the difficulties which Mr. Leng had to encounter. Our conception of the general classification of the Coleoptera has undergone fundamental changes from the LeConte and Horn classification of 1883. Many new characters have been used by subsequent writers, and advanced schemes of classification, based upon these new elements, have been proposed by Lameere in Belgium, Kolbe and Gangl-

bauer in Germany, and Sharp in England, and the general result in the Coleopterological world has been one of some confusion. These systems down to the present time have not been thoroughly adjusted and Mr. Leng had to make a compromise. This difficult work he has done in an admirable manner, as I am told by my expert friends and associates, and in his introduction he has discussed this subject at length. It is an enormous improvement upon previously published North American lists from the fact of this painstaking and enlightening discussion which must have taken an enormous amount of work, as well as from the bibliographical references to original descriptions of new species and genera and the further citation of synopses of monographs that have appeared. The reference system is well handled, and the bibliography, covering more than eighty pages, is remarkably complete and well arranged.

Of course, as one uses the catalogue from day to day in his work, points will be brought out which might suggest improvements, but none have occurred to me in turning the pages. Undoubtedly certain useful changes have occurred to the author and his colleagues in reading the proofs, but in the conditions in the printing trade at this time the expense of alterations is almost prohibitory; and at any rate the defects, if there be any, must be relatively unimportant.

I have talked with several of my associates who are intimately familiar with this group of insects, and all are enthusiastic in their praise of the book. Mr. Leng gives generous acknowledgment of assistance from such authorities as Messrs. Davis, Mutchler, Schwarz, Barber, Bequaert, Schaeffer, Lutz and Böving; and the fact that he has had the assistance of these men intensifies the confidence which we must have in his work.

Although the price of the volume seems high ($10), it is one of those absolutely indispensable things. Every entomologist, including the economic entomologist, must be able to consult it; and all libraries must have it.

The reviewer anticipates with assurance a greatly increased interest in the group of beetles. It is an order of the greatest interest. The specimens are easily collected and are easily preserved. Their compact form and durable structure renders them much more available for collections than any other group of insects. They are much less fragile than the others, and, while they apparently lack the esthetic qualities that attract people to butterflies and the larger moths, their structure is beautifully adapted to their methods of life, and they offer an easy field for the study of certain aspects of broad biological problems.

L. O. Howard

NOTES ON METEOROLOGY AND CLIMATOLOGY

METEOROLOGY AND BALLOON RACING

I am relieved from my anxiety by hearing that the adventurers descended well; . . . that they had perfect command of the carriage, descending as they pleas'd by letting some of the inflammable air escape. . . . Had the wind blown fresh, they might have gone much farther.—Franklin.

The International Balloon Race of 1920.—These words were written by Benjamin Franklin after witnessing one of the first free-balloon flights at Paris, and they are a quaint epitome of the sentiment of free-ballooning, both from the standpoint of the public and that of the pilot. When one has seen the start of a balloon race, with the great silk-skinned bubles rising in the glow of the lowering sun, and the ballast streaming down from the baskets like slender cascades of gold dust, then he may well appreciate the emotions of Franklin in his anxiety for the safety of the balloonists and in his admiration for the skill and judgment required of them. But it is the pilot who can best appreciate the significance of the last statement—"had the wind blown fresh, they might have gone much farther."

No more convincing proof of this can be adduced than that which lies in the distribution of landing points in the International Balloon Race for the Gordon-Bennett cup, which started from Birmingham, Alabama,

late in the afternoon of October 23, 1920. The balloons which departed from Birmingham within half an hour landed at various points along a general line from Mason City, Ill., to North Hero Island, in Lake Champlain. Why did the Belgian DeMuyter land his "glorious *Belgica*" (as he proudly and affectionately calls it)[1] in Lake Champlain, while the American, French and Italian entries were struggling with adverse weather far to the west? It was because DeMuyter found the level where the "winds blew fresh."

Mr. Ralph Upson, the pilot who brought the cup from Europe to America in 1913, has this to say relative to the rôle of meteorology in balloon-racing[2]:

> The history of balloon racing up to the present time shows conclusively that it is taking on more and more of a meteorological character. In the past, races have been occasionally won by mere practical skill in operation of the balloon, but the time when this is possible is rapidly passing, if indeed it has not already passed. In the future, meteorological knowledge instead of being a secondary factor in the assets of a team, will be absolutely the controlling factor.

But the success of DeMuyter did not lie alone in the fact that he is a meteorologist, and that, as he says, he made a careful and critical study of the prevailing types of weather in the United States during the months of October and November: it was also, and largely, because he was able to take advantage of the splendid analyses of the conditions in the upper-air that were made by the United States Weather Bureau observer, Mr. C. G. Andrus, who was detailed to Birmingham to make upper-air soundings for the race. Mr. Andrus has written an article in the *Monthly Weather Review* for January, 1921,[3] in which he discusses the nature of the service rendered to the aeronauts and the weather conditions occurring before and at the time of the race. One of the most striking points in Mr. Andrus' discussion is the agreement between the predicted path of the balloons and the actual paths they followed. A figure is given showing the landing points of the balloons with respect to the predicted path, and it appears that a smooth curve drawn through these points would agree almost exactly with the predicted course. This is remarkable when it is considered that to forecast the probable route of the balloon. it was not only necessary to forecast about two days in advance, but also to take into consideration the probable behavior of the upper winds at all levels during that time. Concerning the flights in general, Mr. Andrus says:

> The balloonists took off from Birmingham just before sunset of the 23d, and floated north-northwestward the first night at elevations averaging 1 kilometer. During the following day they made only moderate speed, mostly toward the north, at various elevations. The following night was the crux; at that time those balloonists who had made the least distance westward had entered the freshening winds of the southeast quadrant of a low-pressure area and rapidly spread away from those pilots who had not gained this advantage. The flying during the last 20 hours was for the most part made in clouds and occasionally in rain, these conditions finally requiring the balloonists to descend.

Upon what data were the conclusions of Mr. Andrus based? In part upon the observations of the Weather Bureau stations, both aerological and surface, these data being telegraphed to Birmingham. He was equipped with apparatus for making pilot balloon observations, also. But what is quite as interesting is that he interpreted these observations in the light of the studies of the Norwegian meteorologist, Bjerknes. The charm of the Bjerknesian interpretation is that it enables one to get a more satisfactory three-dimensional picture of the processes taking place in HIGHS and LOWS than has been usual.

[1] DeMuyter, E., "Comment j'ai gagné la coupe Gordon-Bennett," *L'Aerophile*, December 1–15, 1920, pp. 366–367.

[2] Upson, Ralph H., "Balloon Racing—a Game of Practical Meteorology," *Monthly Weather Review*, January, 1921, pp. 6–7.

[3] "Meteorological Aspects of the International Balloon Race of 1920," pp. 8–10.

It will be worth while, therefore, in these notes to give the salient features of the Bjerknes papers.[4]

The Bjerknes Lines of Discontinuity.—The changes of weather which are associated with the passage of HIGHS and LOWS in the temperate zone are found to depend largely upon a line of discontinuity which marks the boundary between polar and equatorial air. In an individual cyclone, this line of discontinuity consists of the steering line and the squall- or wind-shift, line. Considering as large a portion of the northern hemisphere as possible, this line of discontinuity can be traced from one storm to another so that there is little doubt that it is continuous around the world. North of this line the air is that which "has a low temperature for the latitude, shows great dryness, distinguishes itself by great visibility, and has a prevailing motion from east and north. On the southern side of the line, the tropical origin of the air is recognized by the corresponding signs—its generally higher temperature, its greater humidity, its haziness and its prevailing motion from west and south." This line is called the *polar-front line.*

Sometimes the undulations of the line are such as to cause loops which may represent the cutting off from the parent mass, masses of warm or cold air depending upon how far north or south the tropical or polar air may extend. If the warm air is cut off, the cyclone decreases in intensity and disappears; or, in the case of a new outbreak of polar air a new front is formed behind a too far advanced one; isolated masses of polar air are formed at lower latitudes. This is the formation of great anticyclones, which bring good weather.

[4] Bjerknes, J., "On the Structure of Moving Cyclones," *Monthly Weather Review,* February, 1919, pp. 95–99; "The Structure of the Atmosphere when Rain is Falling" (abstract), *ibid.,* July, 1920, p. 401; Bjerknes, V., "The Meteorology of the Temperate Zone and the General Atmospheric Circulation," *ibid.,* January, 1921, pp. 1–3; appeared also in *Nature* (London), June 24, 1920, pp. 522–524.

In the case of the individual cyclone, the phenomena along this line of discontinuity are about as follows: That part of the line which lies in a general easterly direction from the center of the cyclone is known as the *steering-line.* South of it the air is moving from the south; north of it the air is from the east. Along the line the warm southerly air rises over the denser easterly air. Passing through the center of the cyclone the line extends off in a southwesterly direction and forms the western boundary of the warm tongue of southerly air, and the eastern front of an advancing wedge of cooler northwesterly air. This line is known as the *squall line,* and its passage is frequently accompanied by considerable violence, with thunderstorms and sometimes tornadoes, but usually with only a strong blow, a rise of pressure, a drop of temperature, and, of course, a change of wind direction.

It was on the basis of the advance of these lines of discontinuity that Mr. Andrus was able to predict the path and advise the balloonists to make as little westerly progress as possible during the first night, to stay as far east and north as possible, even if it were necessary to disregard the usual practise in ballooning of staying as low as possible to avoid expenditure of ballast early in the race. The winner followed this advice and had landed in Vermont many hours before the others who had reached no greater distance than Illinois and lower Michigan. This fact demonstrates very clearly that, as Mr. Upson frankly confesses and as Mr. Andrus emphatically states, it was meteorology that won the race.

C. LeRoy Meisinger

Washington, D. C.

SPECIAL ARTICLES

THE CATALYTIC PROPERTIES OF THE RESPIRATORY METALS[1]

The more important physical and chemical properties of the respiratory metals—iron, copper, manganese and vanadium—have long

[1] Contributions from the Bermuda Biological Station for Research, No. 123.

been known. Hitherto, however, the evident points of similarity which these metals possess have not been offered to explain their singular activity in respiration.

In the first place, as Griffiths[2] has pointed out, the atomic weights of these metals differ very slightly from one another: $Mn = 55$; $Cu = 53$; $Fe = 55.9$; $V = 51$.[3] Is such a condition purely accidental, or does it indicate something concerning the chemical affinities of the proteins with which these metals are associated? It should be noted also that the valences of the elements in question are variable to an unusual degree (Cu, 1–2; Mn, 2–7; Fe, 2–3; V, 3–5). So marked a degree of variation may be without theoretical significance, yet it is an interesting coincidence. These metals also closely approximate one another in specific gravity. In addition they all form oxides with great facility. But perhaps the most suggestive property which they have in common is that of catalysis.

It is a commonplace of inorganic chemistry that minute amounts of iron and of manganese hasten many reactions. This is likewise true of both copper and vanadium. But it is much more significant that these same elements also have a very profound catalytic effect upon many physiological processes. One part of manganese in one million greatly accelerates the growth rate of Aspergillus niger.[4] Moreover, the salts of copper, iron and manganese serve as powerful catalaysers for peroxides, and will in some cases replace the enzyme peroxidase. Bertrand[5] believed that his enzyme "laccase" owed its activity to manganese, but it was subsequently shown by Bach[6] that iron could take the place of manganese without altering the activity of "laccase."[7] This latter fact serves as a striking parallel to the replacement of iron by copper and manganese in certain of the respiratory pigments. But this parallel may be pushed still further. When acting upon peroxides, these metals are serving in the capacity of catalysts. Now, it is not wholly impossible that the respiratory metals serve in the same way.

Alsberg and Clark[8] believe that the copper of hæmocyanin acts as a catalyst for oxygen, and if this be the case, the oxygen would be more readily given off to such acceptors as are present in the tissues, thus making hæmocyanin in reality analogous to a peroxide-peroxidase system. As for vanadium, Hecht[9] holds (on the grounds of the relatively low binding power for oxygen which Winterstein[10] reports for ascidian blood) that vanadium, too, probably serves the *rôle* of catalyst in the blood of tunicates. Also, from the description which Griffiths[11] gives of his pinnaglobin,[12] it is not at all impossible that the manganese of this pigment serves in a similar capacity. The fact that the metals are always present in very small quantities further strengthens the catalyst hypothesis. Hæmocyanin, which has a molecular weight of 18.762 (Griffiths), has in its molecule only 63.6 gram molecules of copper. Furthermore, one should recall that in certain sluggish animals respiratory pigments are present which are not associated with any oxidizing metals. These have been investigated extensively by Griffiths,[13] and are called by him achroglobins. An α-achroglobin is found in a limpet, *Patella vulgata,* and a β-achroglobin in chitons. A γ-achroblobin was described for

2 "Respiratory Proteids," London, 1877, p. 60.

3 Since Griffith's work, vanadium has been described by Henze (1911–12, *Zeits. physiol. Chem.*, 72, 494; 79, 215) for the blood of ascidians. The writer includes it, therefore, with the list of Griffiths.

4 Bertrand, C. R., Acad. Sci., Paris, 1912, 154, 381.

5 C. R. Acad. Sci., Paris, 1897, 124, 1032.

6 *Chem. Berichte,* 1910, 43, 364.

7 Bayliss, "Principles of Gen. Physiol.," 1918, London, p. 585.

8 *Jour. Biol. Chem.*, 1914, 19, 503.

9 *Amer. Jour. Physiol.*, 1918, 40, 165.

10 *Biochem. Zeits.*, 1909, 19, 384.

11 "Respiratory Proteids," London, 1897.

12 A respiratory protein containing manganese. It was first isolated from *Pinna squamosa,* from which it derives its name.

13 "Respiratory Proteids," London, 1897.

ascidians, but the presence of vanadium in association with the proteid escaped Griffith's observation. Whether non-metallic respiratory pigments represent degeneration, or whether they are phylogenetic predecessors of metallic pigments, is difficult to decide; but their presence in the animal kingdom shows that the function of oxygenation is not dependent upon the presence of a metal in the pigment molecule—a fact which gives strong indication that the association with metals was occasioned by the need of a greater capacity for ready oxidation and reduction, the need, that is, of a catalyst.

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Harvard University

THE INFLUENCE OF HEAT AND OXIDATION UPON THE NUTRITIVE AND ANTISCORBUTIC PROPERTIES OF COW'S MILK[1]

In a recent paper[2] from the Minnesota Experiment Station we submitted data which indicated that the nutritive and antiscorbutic properties of cow's milk are dependent upon the nature of the feeding materials which constitute the dairy ration.

In April, 1920, a series of studies was initiated with the view of ascertaining the influence of heat upon the nutritive properties and the antiscorbutic potency of milk. The experimental milk used in these studies was obtained from an Ayershire cow fed upon a ration composed of the same types of feeding materials throughout the experimental period. By this method it was hoped that we might eliminate fluctuations in the vitamine content of the dairy ration and thereby reduce to a minimum any variations in the nutritive properties of the milk.

In these studies we have used a total of 163 guinea pigs, and control groups were included in each series. In the first series of experiments it was found that boiled milk was practically equal, in nutritive properties, to the unheated raw milk. The pasteurized milk, heated at 145° F. for 30 minutes, produced scurvy very quickly and all of the animals died in a very short time. Examination revealed the fact that the pasteurized milks had been stirred rather violently with motor-driven propellors, while the boiled milk had not been stirred mechanically. This led us to believe that oxidation had occurred in the pasteurized milks due to the intimate contact of air with the milk particles. Consequently, many new animals have been added with the result that we have been able to show that the nutritive and antiscorbutic properties of cow's milk are destroyed by oxidation. Some destruction occurs when air is bubbled through milk at 145° F. for 30 minutes, but the destruction is much more marked when oxygen or hydrogen peroxide is used. Oxygen and hydrogen peroxide will destroy the antiscorbutic accessory at room temperature although the destructive action is hastened as the temperature increases. Milk may be pasteurized in closed vessels or boiled in the open air without appearing to lose its nutritive and antiscorbutic properties when fed to guinea pigs. When carbon dioxide is bubbled through the milk, it compares very favorably in nutritive properties with the raw milk.

Our work, now in progress, on orange juice shows that the antiscorbutic properties are not destroyed by boiling for 30 minutes. At least, if destruction occurs it is not discernible with the methods employed. Hydrogen peroxide destroys the antiscorbutic factor in orange juice at room temperature, and the speed of the oxidation is hastened as the temperature increases. Oxidation would appear to be a more important factor than heating as far as the nutritive and antiscorbutic properties of milk are concerned.

Edla V. Anderson,
R. Adams Dutcher,
C. H. Eckles,
J. W. Wilbur
Minnesota Experiment Station,
University Farm, St. Paul

[1] Published with the approval of the director as Paper No. 247, of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] Dutcher, R. A., Eckles, C. H., Dahle, C. D., Mead, S. W., and Schaefer, O. G., *J. Biol. Chem.*, XLV., 119–132, December, 1920.

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE BIOLOGICAL STATION AT FAIRPORT, IOWA, AS AN AGENCY FOR PUBLIC SERVICE[1]

THE U. S. Fisheries Biological Station at Fairport, Iowa, combines in a somewhat unique way the functions of a fisheries biological station and a fish-cultural experiment station. Its functions include the propagation and investigation of fresh-water mussels, the conduct of fish-cultural experiment work, investigation of various fresh-water fishery problems, and the promotion both of a fuller utilization of aquatic products and of a broader and more efficient interest in the protection of aquatic resources. With its admirable building, its extensive equipment of ponds and its general environment, it offers unusually favorable conditions for all manner of biological investigations, and the Bureau of Fisheries invites university biologists to avail themselves of the opportunities there afforded for independent research work.

The primary functions of the station are characteristically ecological. In mussel propagation it deals directly with that striking symbiotic relation existing between fish and mussels, the fish being essential to the development of mussels and the mussels promoting, in part directly, and perhaps in greater part indirectly, the food supply of fishes. As a fish-cultural experiment station, it is concerned not so much with fish as with that complex association of fish, insects, molluscs, crustacea, algæ, and other animals and plants, all of which are intimately interrelated and in turn dependent upon physical and chemical conditions of water, bottom soil and land environment—an association which we call in

[1] The functions and opportunities of the Station as expressed by leaders in the dedicatory exercises and conference held at Fairport, Iowa, in October, 1920, are given in this paper, in connection with an account of the exercises and the conference.

more concise and familiar language, a "fish pond."

Nothing so attests public faith in the possibilities of service by a fisheries biological station as the dedicatory exercises and conference held at Fairport on October 7 and 8, 1920. The occasion was marked as one of unusual significance by the attendance of prominent scientists, the representation of leading universities, the collaboration of men prominent in public life, and the hearty cooperation of business men, some of whom came from cities remote from Fairport.

The universities, colleges and scientific institutions represented were the following, in alphabetical order: Cornell College (Iowa), Cornell University (New York), Davenport Academy of Sciences, Doane College (Nebraska), Harvard University, Iowa State College of Agriculture and Mechanical Arts, Iowa State Teachers College, Johns Hopkins University, Leland Stanford Jr. University, Marine Biological Laboratory (Woods Hole, Mass.), Massachusetts Institute of Technology, Massachusetts State Normal School (Westfield), Northwestern University, Purdue University, University of Chicago, University of Florida, University of Illinois, University of Indiana, University of Iowa, University of Michigan, University of Missouri, University of Oklahoma, University of Wisconsin and Yale University.

The morning and afternoon sessions on October 7, were devoted primarily to the industrial and scientific phases, respectively, of the station's functions. All of the addresses were of sufficient general interest to merit printing in full but this unfortunately has proved impracticable. In the following paragraphs each address is represented by abstracts or extracts of such passages as bear most directly upon the significance and functions of a fisheries biological station.

The ceremonies of dedication were presided over by the Hon. Albert F. Dawson, President of the First National Bank of Muscatine, Iowa, formerly member of Congress, who spoke briefly and instructively of the origin of the station.

In presentation of the building to the Department of Commerce on behalf of the public, Professor James M. White, architect of the building, spoke of the value of a pleasing environment to the prosecution of scientific studies, of the contribution of science to the development of architectural forms, and of the possible value of a new sympathy between the architect and the scientist.

The building was received on behalf of the Department of Commerce by the Hon. Edwin F. Sweet, Assistant Secretary of Commerce, who presented a brief address under the title of "Federal and State Responsibilities for Maintaining the Resources of Interstate Waters." Mr. Sweet strongly expressed as a personal view, not that of the Bureau of Fisheries, his belief that the states might advantageously transfer to the federal government the control of fisheries, not only because of the difficulties attending state control in boundary waters, but also because of the lesser influence of local politics in affairs of national administration. He concluded by formally delivering the building to the Bureau of Fisheries.

In a short speech of acceptance Dr. Hugh M. Smith, Commissioner of Fisheries, spoke of the building as an outward sign of a need, an opportunity and an obligation to strive for the accomplishment of great good in behalf of industry. He emphasized the functions of the station in experimental work for the advancement of fish culture, in investigation of fresh-water biological and fishery problems, in promotion of a fuller utilization of the resources of interior waters and in efforts to awaken broader interest in the preservation of useful aquatic animals so that many future generations may partake of nature's bounties as we are privileged to do.

The program of the morning session included an address by Hon. Charles Nagel, Vice-president of the United States Chamber of Commerce and formerly Secretary of Commerce, who had accepted the invitation in terms of unusual cordiality. Mr. Nagel was prevented from attending only by unexpected

engagements arising at the last moment. A congratulatory letter from Hon. William C. Redfield, formerly Secretary of Commerce, was read by Mr. R. L. Barney, director of the station.

This session concluded with an address by Hon. Harry E. Hull, M.C., under the title of "The Significance of the Station to Industries." He discussed the history of the pearl mussel industry, pointed to the service of science in directing measures of conservation and emphasized the national significance of the work of the station.

As the exercises of the morning stressed the industrial relations of the station, so those of the afternoon gave special emphasis to the scientific phases of its activities. The primary address of the afternoon session was by President Edward A. Birge, of the University of Wisconsin, and was entitled "Aquiculture and Science." President Birge congratulated the bureau on the completion of so admirable a building, which he welcomed "not merely for what it is, but even more on account of the promise for the future which is made by its establishment." He had found, he said, that the term "aquiculture" was regarded by some as a peculiarly technical or "high-brow" word though its twin word "agriculture" was looked upon by no one as in any way extraordinary. He compared and contrasted the well-developed science of agriculture (cultivation of plants and animals upon land) with the unfamiliar and largely undeveloped science of aquiculture (cultivation of plants and animals in water). The following quotations from his address are significant.[1]

Now the lake is an organism in the same sense that the soil is one. The fish or the clam is not a thing which grows for itself—and for us—alone in a certain environment. It is an integral part of a complex life, a life regulated by chemical substances set free by its manifold operations. These substances stimulate one kind of growth or activity and check another one; and the utilizable crop of fish or of clam shells comes as only one expression of this complex life, as a sort of by-product of all this intricate activity.

So much as this we know, and we know also that all assured progress in aquiculture depends on our knowledge of this complex life. We must see the problems of fisheries in terms of this life of the waters, just as we see the problem of any specific activity or product of the body in terms of the whole life of which it is an integral part. But we know next to nothing about this life of the waters. We have countless papers on isolated aspects or bits of aquatic life. But there is no knowledge and hardly an attempt to secure the knowledge of the life as a whole—as a "going concern," if I may change my figure. Still less is there any body of knowledge which enables us to place the production of fish—that essential source of food for us—in its proper place in the operation of that "going concern."

. . . We must not be content with "conserving" our fisheries, though we admit with shame that we are not effecting even this beginning of our task. We too must aim to increase the product of the waters and we can do this only as aquiculture rests on a broad and firm foundation of organized knowledge—of science.

We welcome, therefore, the Fairport Biological Laboratory not merely as a notable addition to the scientific resources of the country, but even more as embodying the promise of a new and advanced policy in dealing with the problems of aquiculture. I can express no higher wish for the laboratory and for the great interests served by it than that it may not only embody the promise but express the potency of that policy.

Professor Frank R. Lillie, representing the University of Chicago and the Marine Biological Laboratory of Woods Hole, Mass., having chosen for his theme "The Spirit of Cooperation in the Bureau of Fisheries" said in part:

The cooperation that you here propose with the industries on the one hand and with the universities through their biologists on the other is a fine program which should be to the advantage of both parties. The relations which both will enter into with the government through this Bureau are among those close personal relations with our too impersonal government which contribute to the feeling that we are one people with one set of interests and a mutual loyalty.

After recalling the spirit of the founder of

[1] The quotations in this paper are by permission of the several speakers.

the Bureau of Fisheries, Professor Spencer Fullerton Baird, and the traditions that he established, he continued:

The universities are dedicated to the advancement of learning; the government naturally devotes itself to the promotion of the welfare of its citizens, but looks far ahead with the aid of science to avoid dangers and to create advantages for them. The disinterested pursuit of learning has so often led to great material gains that we have come to feel that all learning is worth while even from a material point of view. Pure and applied science, when compared, must exhibit angles of divergence, but these are not so broad as formerly, and the workers are cooperating more advantageously than ever before. There is an appreciation of the fact that the great material interests of mankind, the increase of health and the increase of wealth, depend to an increasing extent upon effective cooperation of pure and applied science. Neither can advance rapidly without the other. Together they will hasten the day of liberation from shackles of poverty and disease.

The Bureau of Fisheries bears the distinction of practising this cardinal principle of scientific progress from the day of its foundation. The dedication of this building is a reaffirmation of the strong belief and consistent practise of its wise founder.

Professor George Lefevre of the University of Missouri speaking on the subject "The Fisheries Biological Station in Relation to Universities," said in part as follows:

The history of the station thus far furnishes, among other things, a remarkable and unusual example of the carrying through to realization of a definite purpose, guided by a definite ideal and controlled by the scientific imagination. There has been no faltering on the way, no compromise of the ideal of service, until to-day we witness this inspiring fruition of a purpose consistently maintained and finally expressed in concrete form.

The aims and aspirations which the bureau had in mind for the Fairport Station were clearly expressed . . . at the beginning . . . in the following words: "This station is the first permanent fresh-water biological laboratory established by the government, and it is intended to become, not only the leading laboratory in America for the study of fresh-water biology, but one of the most important biological stations in the world."

It was a broad-minded and comprehensive policy of the Bureau for uniting both scientific and economic interests for mutual assistance and inspiration, and one that received the strongest endorsement and encouragement, on the one hand, by the universities, especially those of the middle west, and on the other hand by the pearl button industry.

With singular and striking harmony, essential agreement and understanding, and with unusual clearness of vision into the future, a federal bureau, an important industry, and educational institutions have worked together with a single purpose, for a definite end, and for a common good. Is not such a cooperation a heartening thing, and does not the existence of this station here to-day refute the contention of those apostles of individualism who belittle cooperative effort and maintain that all real progress in science springs from the researches of the isolated, independent laboratory worker?

. . . .

The station is, as has been pointed out by the bureau, quite analogous to the agricultural experiment station, and the service it can render to the development of the aquatic resources of the country is as important and fundamental as is that of the latter to the development of agricultural resources.

Professor C. C. Nutting brought greetings of the State University of Iowa and those of Leland Stanford Jr. University and its president emeritus, Dr. David Starr Jordan. Taking as his theme "The Biological Laboratory as an Aid to Pure Science," Professor Nutting discussed briefly the history of the Bureau of Fisheries, the ideals of Professor Baird and the relations existing in the past between the Bureau of Fisheries and the workers in the field of pure science. He concluded his address with the following question and its answers:

In answer to the question "How can the laboratory best serve as an aid to pure science?" I would say:

First. By proceeding in the future just as it has in the past; by laying a foundation of pure science by the work of the systematist and morphologist and then erecting a superstructure of applied science on this solid basis.

To illustrate just what I mean we have but to refer to the work on the fresh-water mussel. The

exploration of the more important mussel-bearing streams with a view to ascertaining the extent and number of the mussel beds—the source of supply—was done by men trained in the work of pure science. The material thus secured was carefully worked over, classified and described—the work of the systematist—which was embodied in an admirable report. Then Lefevre and Curtis undertook to work out the anatomy and embryology of the mussels of economic importance and to ascertain the species of fish best fitted to act as carriers of the mussel larvæ or glochidia. All of this was purely scientific work, and the results were embodied in a paper entitled "Reproduction and Artificial Propagation of the Fresh-water Mussels," to my mind an excellent piece of work from a purely scientific standpoint.

With this as a basis, the work of propagation of mussels, the infection of fish best suited to act as hosts to the glochidia and the proposing of laws regarding the mussel industry as a whole could be followed intelligently and effectively. And this, of course, is practical or "applied" zoology.

Second. This laboratory, being in operation through the year, in which it differs from most others in this country, studies of the life histories and ecology of fluviatile species can best be pursued here, and should, in my opinion, be distinctly encouraged. Graduate students from our colleges and universities could be detailed to do this work and thus contribute to pure science and at the same time lay the foundations for work of a distinctly economic bearing.

Third. Material secured here, such as protozoans, mussels, annelids and small crustaceans, could be sent to the biological laboratories of neighboring states and serve a valuable end in supplying such laboratories with many forms desired for class work in botany and zoology.

The raw material from which the scientists of the future must, in the main, be secured is found in the college students now in classes; and anything that aids in the preparation of these students for their future life work will ultimately be of prime importance not only to pure science but also to applied science and the welfare of mankind.

The conference on the morning of the 8th was presided over by Professor Stephen A. Forbes, professor of entomology, University of Illinois, and chief of the Natural History Survey of Illinois. The leading address, entitled "The Biological Resources of our Inland Waters" was presented by Professor James G. Needham, of Cornell University, who has epitomized his remarks in the following terms:

Fish culture is a branch of animal husbandry. Animal husbandry makes progress about in proportion as it gives attention to the fundamental needs of animals, which are three: (1) Food, (2) Protection, and (3) Fit conditions for reproduction. Fish culture (as now practised) is not like other lines of animal husbandry because it gives adequate attention to only the last of these three. Further progress will lie in studying: (1) One species at a time, (2) One problem at a time, and (3) in one environment at a time. That is my creed for fish culture and for fish management and it applies to fish forage organisms and to fish enemies as well.

Several zoologists and business men participated in the general discussion relating to the subject of the conference.

The entire occasion was made agreeable and memorable through the generous cooperation of the National Association of Button Manufacturers, who gave luncheons at Fairport on the 7th and 8th and a banquet in Muscatine on the night of the 7th. The banquet in Muscatine was the occasion for a considerable number of extemporaneous talks by the various delegates present, and by persons representing the Station, the Bureau and the Department.

R. E. Coker

BRYOZOA AS FOOD FOR OTHER ANIMALS

Bryozoa are common animals of the coastwise waters everywhere, but they have not been listed with any frequency in the food of other animals—in fact such references are exceedingly rare. It is of some interest, therefore, that I am able to record the fact that certain aquatic birds, at least occasionally, include them in their bill of fare.

Dr. E. W. Nelson, chief of the Bureau of Biological Survey, has recently sent me for determination a small collection of bryozoa taken from the stomachs of the king eider (*Somateria spectabilis*) and the Pacific eider (*Somateria v-nigra*). These ducks were taken

at the Pribilof Islands in the Bering Sea, and the presumption is that the bryozoa are from the same locality. The food records are as follows:

Crisia sp., from stomachs of the king eider and of two Pacific eiders, St. Paul I., Alaska, January 29 and 30, 1918.

Menipea pribilofi Robertson, from stomach of king eider, St. George I., Alaska, January 30, 1918.

Myriozoum subgracile d'Orbigny, from stomach of king eider, St. George I., Alaska, May 3, 1917.

Cellepora surcularis Packard, from stomachs of the Pacific eider, St. Paul I., Alaska, Mch. 21, 1915, and from the king eider, St. Paul I., Alaska, December 13, 1914 and January 29, 1918.

The amount of material in each case was small. The *Crisia* colonies were broken scraps and undeterminable as to species because of the lack of ovicells, though the general appearance was that of the common *C. denticulata* Lamarck. *Myriozoum subgracile* was represented by a branched portion 9 mm. long by 3 mm. thick, and *Cellepora surcularis* by irregular nodules 4 to 12 mm. in greatest diameter.

In all cases the animal matter seemed to have been digested out, leaving only the chitinous or calcareous matter of the ectocyst. Aside from the fact that they were considerably broken up, the specimens were in good condition for study, being as clean as though they had been treated with Javelle water. As Dr. Nelson suggests in a letter, it is probable that the ducks ate the *Crisia* and *Menipea* incidentally with other food, as these small branched species often grow attached to other organisms. The *Myriozoum* and *Cellepora* being nodular, may have been swallowed in lieu of pebbles.

In general the bryozoa must afford comparatively little nutriment, as the indigestible portion is so large, yet an animal pressed for food might be able to eke out an existence on them.

Certain fishes that habitually browse around ledges, rocks, wharves, etc., and which have teeth adapted for cutting off and crushing the shells of their prey, are known to include Bryozoa in their diet with some regularity. Thus, the cunner, *Tautogolabrus adspersus*, and the blackfish or tautog, *Tautoga onitis*, feed on bryozoa along with other hardshelled organisms. (See Sumner, Osburn and Cole, "Biological Survey of the Waters of Woods Hole and Vicinity," Bull. U. S. Bureau of Fisheries, Vol. XXXI., Part 2, 1911.) The kingfish, *Menticirrhus saxatilis*, also has been known to feed on bryozoa. The writer has observed *Bugula turrita* Desor and *Lepralia pallasiana* Moll among the stomach contents of the puffer or swellfish, *Spheroides maculatus*. On one occasion a couple of young puffers were placed over night in a finger bowl containing some colonies of the Endoproct, *Barentsia major* Hincks, and the next morning it was discovered that the puffers had returned my kindness in keeping them alive a few hours longer by eating the heads off of the most of the *Barentsia*. I have seen a considerable mass of *Bugula turrita* taken from the stomach of a smooth dogfish, *Mustelus canis*, and on several occasions have had referred to me for identification, nodules of *Smittina trispinosa nitida* Verrill and *Schizoporella unicornis* Johnston, from the stomachs of sharks. In one case the colony was half as large as my fist.

Bryozoa often grow in the greatest profusion, covering piles, rocks, shells, seaweed, etc., with growths so dense that they may entirely obscure the objects to which they are attached. At Woods Hole, Mass., during the summer of 1919, observations were made on *Bugula turrita*, growing on the rock wall of the Bureau of Fisheries dock, and on *Lepralia pallasiana*, encrusting the piles and timbers under the Coast Guard dock. Though in both cases the substratum was practically covered by the bryozoa and there were many other animals present, very few of the colonies showed injury of any sort. In nearly every case the colony form was perfect. It has been my experience in many years of dredging that

bryozoa colonies are usually complete, unless broken during dredging operations.

The bryozoan individual is always small, being rarely half as large as a pin head, but the colonial mass is often of sufficient size to render them desirable as food for numerous organisms, were it not for the fact that in nearly all cases they are well protected by heavy chitinous or calcareous walls. Only those animals provided with strong incisorial teeth or which can swallow the colony whole, can utilize them. Predaceous worms and other invertebrates probably are unable to feed on them to any extent, for in addition to its shell, the bryozoan is so highly irritable to tactile stimuli that it retracts into its shell with great rapidity at the slightest touch. Possibly some of the softer-bodied ctenostomes may serve as food for other invertebrates, but observations on this point are apparently lacking.

It should be added that the statoblasts of the freshwater bryozoa are often eaten by young fishes. During a survey of the fishes of Ohio, made during the past summer, statoblasts of *Pectinatella* and *Plumatella* were found among the stomach contents of the young of the large-mouth black bass, *Micropterus salmoides*, the crappie, *Pomoxis annularis*, the blue-gill sunfish, *Lepomis pallidus* and the gizzard shad, *Dorosoma cepedianum*. That these were picked up for food among other organisms of the same size there can be little doubt.

Raymond C. Osburn
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COPPER IN ANIMALS AND PLANTS

In a recent number of *The Journal of Biological Chemistry* (Vol. 44, pp. 99–112, Oct., 1920) W. C. Rose and M. Bodansky report the finding of copper in various marine organisms, including Coelenterates, Mollusca, Crustacea, Elasmobranchs, and Teleostomi. As some of the writer's work bears on this subject, the following note is offered.

In some recent investigations on the respiration of insects the writer incinerated both the blood and entire specimens of over 30 species of insects, representing the chief orders. The ash was analyzed for copper, on the supposition that the copper present serves as the nucleus of a respiratory pigment, namely hemocyanin. In every case the ash reacted positively for copper with several reagents. The amount of copper present in insect blood is nearly proportionate to that present in crayfish blood, which was used as a control.

In addition to insects and crayfish, other Arthropods were incinerated, including several species of plankton Crustacea, spiders, daddy long-legs, and centipeds. In all cases copper was found. As representatives of other phyla *Volvox*, *Lumbricus*, *Ascaris*, snails and slugs, and the blood of garter snakes and human blood were incinerated. Of these all but the vertebrate blood reacted positively to tests for copper. As a matter of fact, the snake blood also appeared to show a minute trace of copper, but as the reaction developed with only one of the reagents used, and then only after several hours under alcohol vapor, this particular experiment is inconclusive.

The foregoing results indicate that the element copper has a wider distribution in living organisms than heretofore accepted. Its function has been definitely determined only for mollusks and Crustacea, where it forms the nucleus of a respiratory protein. Its presence in other Arthropods is explained on the same basis, that is, in all Arthropods copper forms the nucleus of hemocyanin. This is all the more probable, since, as already stated, the amounts present in insect blood, spiders and centipeds are proportionate to the amounts present in the crayfish blood used as a control.

In considering the source of the copper the writer analyzed the water of a creek from which most of his aquatic material was taken, and found distinct traces of the metal. The water as a source of copper is of importance to aquatic animals. It was shown, however, that terrestrial insects, including such highly specialized families as bees, ants and wasps, contained copper. These and other terrestrial insects, especially the herbivores, could derive

their copper only from their plant food. In view of this fact about a dozen species of plants were incinerated. In all cases, whether the portion incinerated was taken from the stem, or the leaves, or fruit, the ash reacted positively.

In general, copper was present only in traces in plants, not at all in amounts comparable to that present in insects. It is probable that the copper ion is inactive in plants, that its presence is due to mechanical storage, and that it plays no active rôle in the physiology of the plant.

It is evident, however, from the experiments performed, that copper is widely distributed in both the plant and animal world. In the former it is present only in traces, and probably inactive, while in the latter it is present in measurable quantities and its rôle appears to be active.

A more detailed account of these investigations will be published in the near future.

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University of Idaho,
Moscow, Idaho

SCIENTIFIC EVENTS

DIRECTORS OF RESEARCH AND SCIENTIFIC QUALIFICATIONS

The Right Hon. F. D. Acland recently asked in the House of Commons, as we learn from *Nature,* whether the lord president of the council "is aware that dissatisfaction is being expressed by scientific workers with the appointment of a man without scientific qualifications as director of research to the Glass Research Association; whether, as the Department of Scientific and Industrial Research provides four fifths of the funds of the association, the department was consulted before the appointment was made; and does he approve of the appointment as giving a guarantee that state funds devoted to scientific research will be wisely expended?" Mr. Fisher replied to the question, and his answer included the following statements, which concerned a director for the work called from the United States: (1) The successful candidate has a wide and successful experience of scientific research into the problems of the glass industry, and is considered by the association to be the man best suited for organizing and directing the research needed by it. (2) The responsibility for the selection of a director of research rests in each case with the research association concerned, and not with the Department of Scientific and Industrial Research, which has no power to approve or disapprove the appointment of any individual. (3) The department guarantees three quarters of the expenditure of the research association up to a certain limit, but payment of the grant is conditional, among other things, on the approval by the department of the program of research and of the estimate of expenditure thereon. (4) The advisory council of the department, after considering all the relevant circumstances with great care, recommended the approval of the expenditure involved in this director's appointment.

ELECTIONS BY THE NATIONAL ACADEMY OF SCIENCES

The scientific program of the meeting of the National Academy of Sciences, held in Washington on April 25, 26 and 27, has been printed in Science, and other information concerning the meeting will be published later.

At the business session of April 27, the president of the academy, Dr. Charles D. Walcott, presented his resignation, but at the earnest request of the academy, he consented to serve the remaining two years of his term. The resignation of the foreign secretary, Dr. George E. Hale, was accepted with regret, and with the expression of high appreciation of his able work in that office. Dr. R. A. Millikan was elected foreign secretary, to complete the unexpired term of Dr. Hale. Dr. Hale was elected a member of the council, and Dr. Raymond Pearl was reelected.

The following were elected to membership:

Frank Michler Chapman, American Museum of Natural History.

William LeRoy Emmet, General Electric Company, Schenectady, N. Y.

William Draper Harkins, University of Chicago.

Ales Hrdlicka, United States National Museum.

Arthur Edwin Kennelly, Harvard University.

William George MacCallum, Johns Hopkins University.

Dayton Clarence Miller, Case School of Applied Science.

George Abram Miller, University of Illinois.

Benjamin Lincoln Robinson, Harvard University.

Vesto Melvin Slipher, Lowell Observatory.

Lewis Buckley Stillwell, 100 Broadway, New York.

Thomas Wayland Vaughan, United States Geological Survey.

Donald Dexter Van Slyke, Rockefeller Institute.

Henry Stephens Washington, Geophysical Laboratory.

Robert Sessions Woodworth, Columbia University.

Foreign Associates

William Bateson, John Innes Horticultural Institution, Merton Park, Surrey, England.

C. Eijkman, University of Utrecht, Holland.

THE PRINTERS' STRIKE AND THE PUBLICATION OF "SCIENCE"

SCIENCE has been issued weekly from the same press without intermission for over twenty-six years, but it is possible that the present number may be delayed. The widespread strike of compositors for a forty-four hour week affects the offices at Lancaster, Easton and Baltimore, in which a large part of the scientific journals of the United States are printed. The printing office will do all in its power to bring out the number at the regular time, and at present the pressmen are at work. In order to get the number through the press articles in type are being used with the exception of a few news notes. This unfortunately requires the postponement of the publication of accounts of the recent meetings of the National Academy of Sciences, the American Chemical Society, the Executive Committee of the American Association for the Advancement of Science, the Joint Committee on Conservation and other material of current interest. It may be noted that the advertisements are in type, and advertisers have been requested to continue to use the same copy, so that no sacrifice of reading matter is made for the advertisements. The number is, however, reduced by eight pages to facilitate its publication.

SCIENTIFIC NOTES AND NEWS

AT the recent meeting of the American Chemical Society at Rochester, Professor Charles F. Chandler and Dr. William H. Nichols were unanimously elected honorary members of the society.

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, has been elected an honorary fellow of The Royal Society of Tropical Medicine and Hygiene of London at a meeting of the council of that society, held on April 8, 1921.

THE William H. Nichols medal of the New York section of the American Chemical Society was presented to Professor Gilbert M. Lewis, dean of the department of chemistry of the University of California on May 6. The program was: "The man and his work," remarks by Arthur B. Lamb, John Johnston; presentation of medal by John E. Teeple; acceptance and address, "Color and molecular structure," by Professor Lewis.

THE Royal Geographical Society of Great Britain, with the approval of the King, has awarded to Vilhjalmur Stefansson their Founder's Medal for his "distinguished services to the Dominion of Canada in the exploration of the Arctic ocean." The medal is to be presented at the anniversary meeting of the society in London on May 30. Mr. Stefansson will then be on a lecture tour in the western United States and consequently unable to attend, and it is expected that the High Commissioner for Canada will receive the medal on his behalf, as the Stefansson Arctic expedition of 1913–1918, of which this award is a recognition, was a Canadian naval expedition.

DR. STEPHEN SMITH, first president of the American Public Health Association, now ninety-eight years old, will welcome members of the association at the fiftieth annual meeting next November.

DON JOSÉ RODRIGUEZ CARRACIDO, rector of the University of Madrid, has been elected president of the Spanish Association for the Advancement of Science.

The meeting of the Academy of Sciences of Cuba on March 26 was a special session in honor of the return of Dr. Juan Guiteras from his mission to Africa to study yellow fever and other tropical diseases on behalf of the Rockefeller Foundation. It will be remembered that General Gorgas started with him, died in London.

Under the auspices of the Rockefeller Foundation Major-Gen. Sir Wilmot Herringham, consulting physician to St. Bartholomew's Hospital, vice-chancellor of the University of London, and Sir Walter Fletcher, senior demonstrator in physiology, Cambridge University, are traveling over the United States to study medical and scientific institutions for the British government.

The biological expedition to Spitzbergen, organized in Oxford University, is to set out in June, under the leadership of the Rev. F. C. R. Jourdain, and will devote its attention principally to ornithological work.

Professor Arthur H. Graves, collaborator, Office of Investigations in Forest Pathology, Bureau of Plant Industry, U. S. Department of Agriculture, and formerly assistant professor of botany in the Sheffield Scientific School and Yale School of Forestry, has accepted the appointment as curator of public instruction at the Brooklyn Botanic Garden to begin September 1, 1921.

Dr. R. A. Millikan, of the University of Chicago, delivered the first annual address before the Crowell Scientific Society of Trinity College, Durham, N. C., April 28. This society is a reorganization of the general scientific society which had been in existence for the past thirty years. Physicists and students from various parts of the state were in attendance.

Dr. David White, chief geologist of the United States Geological Survey, delivered a lecture on the "Deposition of oil shales and cannels," at the School of Mines of Pennsylvania State College on April 29.

Professor Albert Einstein, lectured at the University of Chicago on May 3, 4, and 5. The general subject of his lectures was "The Theory of Relativity."

William Robert Brooks, director of the Smith Observatory since 1888, and professor of astronomy at Hobart College since 1900, died at his home in Geneva, N. Y., on May 3, at the age of eighty-five years.

Dr. Albert C. Hale, formerly for twenty-nine years head teacher in the department of physical science at the Boys' High School, Brooklyn, secretary of the American Chemical Society for thirteen years, died on April 22 at the age of seventy-five years.

Captain E. W. Creak, C.B., F.R.S., formerly superintendent of compasses in the British Admiralty, died on April 3 at the age of eighty-four years.

UNIVERSITY AND EDUCATIONAL NEWS

The State Legislature of Texas passed an act which has now been approved by the governor appropriating one million, three hundred and fifty thousand dollars to be used in buying property adjacent to the present campus of the University of Texas. It is expected that about 120 acres, a considerable part of which is residence property, will be purchased.

Mrs. Ransohoff, the widow of Dr. Joseph Ransohoff, former professor of surgery at the medical college, has given $25,000 to the medical college of Cornell University toward an endowment fund for the establishment of a chair of surgery and anatomy. The money will be used as a nucleus for such an endowment, the minimum of which is estimated at $150,000.

Dr. Paul H. M.-P. Brinton, of the chemical department of the University of Arizona, has been appointed professor of analytical chemistry in the University of Minnesota.

Dr. R. W. Shufeldt has been elected professor in nature study in the summer school of the George Washington University.

Dr. John Edward Anderson, instructor in psychology at Yale University, has been promoted to an assistant professorship.

DISCUSSION AND CORRESPONDENCE

ENGLISH PRONUNCIATION FOR THE METRIC SYSTEM

DOUBTLESS practically all scientific workers favor general use of the decimal or metric system of weights and measures. Obviously there are certain unavoidable difficulties, both psychological and economic, which must be overcome before this end can be attained. It seems inconsistent, then, for users of the system to add unnecessarily, even in small degree, to the popular prejudice against the change.

Just such an unnecessary minor difficulty is produced by a common American practise in the pronunciation of metric names containing the prefix *cent-*. As a matter of history, it is true, these names came to us from the French; they could just as well, however, have been taken directly into English from the Latin and Greek. In most respects these words are already, by common consent, fully Anglicized; we never employ the French syllabic stress, nor do we use the French sound of the *r* or the *i* or the second *e* in *centimeter.* Why, then, should we ever say "sänt" (sahnt), approximating the sound in *centime,* for the straightforward English "sĕnt" (as in *center*)? Although this hybrid pronunciation is (for example) not recognized by the Funk and Wagnalls "New Standard Dictionary," it is certainly widely prevalent in this country, and it doubtless adds a little to the unthinking popular prejudice against the metric system as a "high-brow" foreign innovation. The same considerations apply to the word *centigrade,* which has come into English by the same route.

In various other English words, such as *cental, centipede,* and *centenary, cent* is regularly pronounced as in the case of the name of our monetary unit. The only excuse for a different practise for the metric system is the fact that these words were first used by the French. They are truly international words, however, and as a matter of practical convenience they should be naturalized in each language in which they are used. Any attempt at precise international uniformity for such words is obviously predestined to failure, except as this uniformity comes with the general adoption of an international auxiliary language such as Esperanto—and even when this happens the usage of "national" languages will probably remain unchanged.

And while we are about it, in conformity with the definite trend of modern English usage, can we not all agree to drop the "me" from *gram(me)*, and to write *meter* rather than *metre?*

HOWARD B. FROST

CITRUS EXPERIMENT STATION,
RIVERSIDE, CALIFORNIA

EXTRAMUNDANE LIFE

TO THE EDITOR OF SCIENCE: In SCIENCE for March fourth an eminent astronomer speaks of the "strong probability that intelligent life exists in abundance throughout the universe." May I inquire where I can secure any *evidence* in support of this statement? I should like to know upon what grounds I may assert that life exists anywhere but upon this earth. Secondly, how may I know it is intelligent? And thirdly, how may I know that it exists in abundance? The whole assertion savors to me of newspaper pseudo-science.

HUBERT LYMAN CLARK

WILLIAMSTOWN, MASS.,
April 11

TO THE EDITOR OF SCIENCE: On April 4 I had the pleasure of suggesting by letter directly to Professor Hubert Lyman Clark that he read Professor Simon Newcomb's superb essay of thirteen printed pages on this very old subject, entitled "Life in the Universe," and contained in his volume, "Side-Lights on Astronomy" (Harper and Brothers), pp. 120–132, 1906. One of Newcomb's concluding sentences (p. 132) reads, "It is, therefore, perfectly reasonable to suppose that beings, not only animated, but endowed with reason, inhabit countless worlds in space."

W. W. CAMPBELL

MOUNT HAMILTON, CALIFORNIA,
April 25

SCIENTIFIC BOOKS

The Sumario Compendioso of Brother Juan Diez. The earliest mathematical work of the New World. By David Eugene Smith. 1921. Boston and London: Ginn and Company. 65 pages. Price $4.00.

Those who are interested in the earlier mathematical developments only in so far as it can be shown that these developments have contributed directly to the present extent of our mathematical knowledge will find little to interest them in the present small volume. It is not claimed that this volume exhibits any decided step forward in mathematics or that it exerted a great influence on later works devoted to the same subject. There are, however, many mathematicians and historians who will doubtless be very glad to have an opportunity to read in their own language the excellent translation which Professor Smith has here provided of what seems to be "the earliest mathematical work of the New World."

It is desirable that the student of the history of arithmetic should be able to consult original sources. By the publication of the "Rara Arithmetica" about a dozen years ago and by the publication of the present volume Professor Smith has rendered very valuable service to those who desire to consult such sources. The historical notes which appear in these works are exceedingly valuable even if they are often less extended than might appear desirable. In the present volume two pages or less of such notes relate to each of the following four subjects: The Mexico of the period, printing established in Mexico, general description of the book, and nature of the tables.

An important oversight should be noted here in order that the reader may not be misled in regard to the time when the book under review, which was first published in 1556, became known to American educators. To establish the fact that the reader is seriously exposed to misconception as regards the point in question and also on account of the interest which these statements may command, we quote the first three sentences of the preface.

If the student of the history of education were asked to name the earliest work on mathematics published by an American press, he might, after a little investigation, mention the anonymous arithmetic that was printed in Boston in the year 1729. It is now known that this was the work of that Isaac Greenwood who held for some years the chair of mathematics in what was then Harvard College. If he should search the records still farther back, he might come upon the American reprint of Hodder's well-known English arithmetic, the first text-book on the subject, so far as known, to appear in our language on this side the Atlantic.

As some "student of the history of education" may be assumed to have read the "Rara Arithmetica" and noted that on page 286 thereof the work under review was called "the first arithmetic printed in America" it seems strange that such a student should have been overlooked while the said preface was written. One is perhaps still more surprised to find that such an intelligent student was also overlooked when Professor Smith prepared the article relating to the book under review for the last January number of the *American Mathematical Monthly* as well as when he read a paper before an intelligent audience during the recent meeting of the American Association for the Advancement of Science at Chicago. On both of these occasions the substance of the part of the preface quoted above was given without any reference to the fact that one of the most interesting elements relating to the subject under consideration had been noted a dozen years earlier in the "Rara Arithmetica."

The emphasis on this oversight in such a public place seems to be justified by the facts that this emphasis may tend to lessen the danger that readers of the book under review will be misled as regards an interesting historical fact, and that one could not condemn in too strong terms one of the motives which might possibly be ascribed to the translator and editor by the reader after discovering that he had been misled by the statements quoted above. Being forewarned such a reader is more likely to attribute these statements to an astounding oversight by an unusually painstaking and careful writer.

Tables make up the greater part of the original work but as they are no longer of

any importance only one page is shown in facsimile in the present edition. The rest of the text is reproduced on the left hand pages while the translation appears on the following pages. The last six pages are devoted to algebra, chiefly relating to quadratic equations, and, in closing, the author states that he "wished to set down the things which are necessary and familiar in this kingdom." The formula near the bottom of page 37 is not clearly stated. Professor Smith's name is a sufficient guarantee that the work is in an attractive form.

G. A. Miller

University of Illinois

Introduction à l'étude pétrographique des roches sédimentaires. Par M. Lucien Cayeux. Mémoires pour servir à l'explication de la carte géologique détaillée de la France. Paris: Imprimerie Nationale 1916. Quarto, 1 vol. text, pp. viii + 524, 80 figures; 1 vol. LVI plates.

It is a curious fact that although Sorby, the father of modern petrography, was especially interested in sedimentary rocks, those who followed him, with the exception of a small but persistent succession of workers in his own country, almost abandoned them in favor of the igneous rocks. The author of the book under review has elsewhere suggested that this was perhaps due to the lure of greater mystery in the igneous rocks and to the lack of knowledge, before the *Challenger* expedition, about the sediments of today. The reviewer has always been inclined to attribute the preference for the study of igneous rocks to their greater and more obvious diversity, which made it easier to find something new in them and gave them a greater esthetic attractiveness. Whatever the cause the present work will be the most powerful influence that has yet been brought to bear in changing that tendency. Indeed, in French-speaking countries Cayeux's influence is already very manifest. If the beauty of the sedimentary rocks has been considered inferior the enthusiasm of the author will surely correct that impression.

The work marks an epoch in its field and is written with a breadth of view worthy of the fundamental importance of the sedimentary rocks in the interpretation of the history of the earth. The author not only stands alone in the extent and thoroughness of his monographic investigations in this field, but as the successor of Élie de Beaumont, Fouqué and Michel-Lévy at the Collège de France he is, so far as the reviewer knows, the only person occupying a chair devoted entirely to the teaching of the petrology of sedimentary rocks. On his inauguration the name of the chair he occupies was changed from "Chair of the Natural History of Inorganic Bodies," to "Chair of Geology," but it might well have retained its old name, for as he says in his inaugural address, "The science of the sedimentary rocks is and will remain for us *a natural history of the ancient and modern sediments.*" It is the treatment from this point of view and the enthusiasm and wide personal experience which the author brings to it that gives to a book which one might expect to find dry and technical a freshness, interest, and charm that make it fascinating reading. Furthermore, the book is so full of original observations drawn from the writer's many years of study that no student of sedimentary rocks, be he petrographer or merely stratigrapher, can afford to leave it unread.

The work is divided into two parts. The first deals with methods of analysis of sedimentary rocks, the second with the diagnostic characters of the constituents, which fall into two groups—the minerals and the remains of organisms.

The first part is refreshingly free from pedantry or love of technique as an end in itself, though the artist's pleasure in some refined and delicate method often finds expression. Methods of handling rocks of different types according to their induration or susceptibility to attack by acid are discussed, but the possible complexity of the procedure appropriate to any individual rock and the need of adapting the methods used to the particular rock and to the object of the investigation are pointed out. Quantita-

tive results are sought, but the difficulties of obtaining them are recognized and the usefulness of quantitatively expressed results that may not be accurate in themselves but still may permit of valuable comparison with one another, is admitted. The reader feels throughout no impulse on the part of the author to fix standards but merely that desire to give help, out of his own rich but painfully accumulated experience, which led him to prepare the book. Any one who comes to this book for a rigorous method that will enable him to turn out orthodox studies of sedimentary rocks will be disappointed, but those who want to help in advancing the borders of knowledge about this subject will find guidance and inspiration. The methods of analysis are grouped under three heads—physical, microchemical and chromatic. The physical analysis includes different processes sometimes grouped in this country under mechanical analysis, and the preparation of thin sections which in dealing with weakly bound sedimentary rocks often calls for special methods. The demonstration of the ease of application and delicacy of microchemical analyses is one of the outstanding features of the book. Under chromatic analysis the author discusses various methods of staining. In the discussion of all these methods he selects, weighs, evaluates and contributes on the basis of his own experience, without attempting any formal completeness.

Perhap Cayeux's greatest achievement is the interest he is able to give to his discussion of the minerals of sedimentary rocks, of which of course he considers only the more common, both essential and accessory. It is in this part of the book that his treatment of the subject as natural history is illustrated in the most novel and interesting way. The individual mineral is to the author a record of environments—of the environment in which it originated and of those through which it subsequently passed—and it therefore contributes to the reconstruction of the history and geography of the past.

The last part of the book deals with the remains of organisms as constituents of the rocks. Needless to say, specific determinations of organisms are not the purpose of a treatise on petrography. But here, too, the problem of past environment as recorded by the remains, both as remnants of once living organisms and as mineral substances, is the object of study. This part therefore deserves the attention of paleontologists as well as of petrographers and stratigraphers.

Vivified throughout by the author's own experience the work must lack that perfect completeness that would assure it against being found defective in the treatment of some special topics or methods that may be in favor with individual readers. But every reader will surely be glad to accept these omissions for the sake of the vigor and readibility that go with them. American petrographers, for instance, will be struck by the absence of any discussion of the use of liquids of known indices of refraction in the determination of minerals. But as compensation they may profit by adopting some of the elegant microchemical tests described, which have the advantage that they can often be applied directly to the thin section and do not require the disintegration of the rock. Likewise the suggestions given on pages 305 to 309 for the determination of minerals by their general appearance may be a valuable antidote to the habit into which the devotee of "index liquids" is likely to fall, of resorting to his liquids in blind routine, just as the man with the slide rule habit gets out his machine to find the product of 2×2.

The physical quality of the book is worthy of its subject matter, and it is a fact for contemplation and an honor to the fine French scientific spirit, exemplified by the entire work, that it bears the date 1916.

Marcus I. Goldman
U. S. Geological Survey

SPECIAL ARTICLES

NOTES ON THE OCCURRENCE OF GAMMERUS LIMNAEUS SMITH IN A SALINE HABITAT

The capacities of various organisms for withstanding relatively wide ranges of environmental conditions has received considerable

attention at the hands of physiologists and students of animal behavior, and is a problem which must ultimately be considered in greater detail by ecologists, students of geographic distribution and organic evolution.

The purpose of this note is merely to call attention to the occurrence of *Gammerus limnaeus* Smith,[1] normally a fresh water[2] species, in a peculiar and rather saline habitat.[3]

In the summer of 1920 the writers visited the Ice Spring Craters lava field of the Sevier Desert in the ancient Lake Bonneville basin described in detail by Gilbert.[4] On climbing down into the old lava vent[5] of the Terrace crater we were surprised to find a small crustacean abundant in the small pool of clear water at the bottom. It was noted that a number of the animals were very slightly pigmented, apparently indicating that in the semi-darkness of the pool they were approaching cave conditions. In all instances, however, the eyes were fully pigmented. The presence of the *Gammerus* led to the assumption that the water was non-saline and we were preparing to replenish our water bag when taste showed it to be distinctly brackish.

A sample of the water was therefore taken in a clean Mason fruit jar from which it was afterwards transferred to citrate bottles for shipment to the laboratory. The water had a freezing point lowering of 0.410° C., indicating an osmotic concentration of 4.94 atmospheres and an electrical conductivity of .0138 reciprocal ohm. The hydrogen ion concentration of the water (determined electrometrically) was $C_H = 0.409 \times 10^{-7} = p^{H}7.388$. Analysis showed the following composition.

	Grams per Liter
Total solids (at 110°)	8.5666
Total solids (at 210°)	8.1467
Total solids (ignited)[6]	7.6400
CO_3[7]	none
HCO_3[7]	0.2187

Mineral Analysis

	Grams per Liter	Per Cent. of Total Solids (Ignited)
SiO_2	0.0720	0.94
$Fe_2O_3Al_2O_3$	0.0030	0.04
Ca	0.3305	4.33
Mg	0.2560	3.35
Na	1.9750	25.85
K	0.3050	3.99
Cl	3.4120	44.66
SO_4	1.3260	17.36
CO_3[8]	0.1075	1.41
Total	7.7870	101.93

[1] We are indebted to Mr. Waldo L. Schmitt, associate curator of marine invertebrates in the U. S. National Museum, for the determination of the species. The specimens are in the National Museum.

[2] The key to the taxonomic and distributional literature is furnished by Weckel's paper on the fresh water Amphiopoda of North America (*Proc. U. S. Nat. Mus.*, 32: 42–44, 1907), and individual citations need not be given here. The species was first dredged in Lake Superior. It has been taken near Long's Peak, Colorado, at an elevation of 9,000 feet; from a cool spring, Fire Hole Basin; from Shoshone Falls, Idaho; Flathead Lake, Montana; and from the Yellowstone National Park. It is reported from Fort Wingate, N. M., and from the Wasatch Mountains and Salt Lake City, Utah. It is impossible to determine from the records whether all the localities were fresh water habitats, but that it is typically a fresh water form can admit of no possible doubt. It has been taken from the stomachs of trout from brooks near Marquette, Mich.

[3] The genus *Gammerus* has species which occur in more or less saline coastal habitats and in non-saline inland waters.

[4] Gilbert, G. K., "Survey West of the 100th Meridian," Vol. 3, pp. 136–144; also "Lake Bonneville," Monographs U. S. Geol. Survey, I., pp. 320–325, 1890.

[5] The lava vent is a circular tube, at one side of the wide crater, about 12 feet in diameter inclined 10° or 15° from the vertical. It can be explored for about 25 feet when progress is stopped by water.

[6] There was apparently considerable organic matter in solution. This could easily be derived from bat guano which was observed on the lava ledges surrounding the pool.

[7] Carbonates and bicarbonates were determined by the titrametric method proposed by Scales (SCIENCE, N. S., 51, p. 214, 1920).

[8] Calculated from bicarbonate data according to the formula $2RHCO_3 + \text{heat} = R_2CO_3 + CO_2 + H_2O$.

Hypothetical Inorganic Composition of the Solution

	Grams per Liter	Per Cent. of Total
Na_2SiO_3	0.1460	1.84
$Ca(HCO_3)_2$	0.2913	3.68
$CaSO_4$	0.8780	11.08
$MgSO_4$	0.8855	11.18
$MgCl_2$	0.3023	3.81
KCl	0.5875	7.42
NaCl[9]	4.8330	60.99
Total	7.9236	100.00

The Terrace crater, and indeed all of the craters of the Ice Spring Craters group, is unquestionably post-Bonneville in origin. There is no trace of wave work on the outer slopes of the craters such as are so conspicuous on Pavant Butte to the north, and neither lacustrine sediments nor evidences of subaqueous erosion appear on the surface of the evidently recent lava fields as they do on the Fumarole Butte lava field to the northwest.

The depth of the vent of the Terrace crater is 260 feet below its general rim and 220 feet below the sill of the last outflow. The problem of the original introduction of *Gammerus* into the small pool of water occupying the bottom of this crater is that of the transportation of small crustacean species or their eggs in general. The point of physiological interest is the occurrence of this species, hitherto reported from non-saline waters, in water of this concentration.

Ross Aiken Gortner,

Division of Agricultural Biochemistry, University of Minnesota,

J. Arthur Harris,

Station for Experimental Evolution, Carnegie Institution of Washington

[9] An average value based on NaCl contents of 4.8790 gr. calculated from residual Na and 4.7870 calculated from residual Cl. The difference of 0.092 gram per liter is within experimental error when one remembers that the above calculations are purely empirical and also when one considers that in some instances the actual analytical values, and consequently accompanying experimental errors, were multiplied by 50 to bring the calculation to a liter basis.

AN EYELESS DAPHNID, WITH REMARKS ON THE POSSIBLE ORIGIN OF EYELESS CAVE ANIMALS

During the past nine years vast numbers of Cladocera of several species have been reared in the writer's laboratory. For one purpose or another many thousands of these have been examined with the microscope. About a year ago was found the only marked aberration of the eye structure which has been noted. This was a *Simocephalus* without any trace of an eye.

Unfortunately this individual was discovered among the small number just killed for use in making some permanent slide mounts. The killing of this individual was unfortunate in that a Cladoceran when killed becomes somewhat opaque while the live animal is so transparent that internal structures can be clearly distinguished. Nor was the differentiation so good in the completed mount as in a live animal. It was clear however both in the freshly killed specimen and in the mount that not only the eye pigment but the entire eye structure was lacking. The ocellus was present and normally pigmented. While it is not quite demonstrated in the mounted specimen it is probable that the optic ganglion is normally developed in the eyeless individual.

It is a source of keen regret to the writer that this eyeless individual was not discovered alive so that offspring could have been obtained from it and light thrown on the nature of the peculiarity, whether of genetic consequence or merely an accident in development. No eyeless individuals were found among sibs and many offspring of sibs of this eyeless individual. This fact however does not convince one that eyelessness in this case may not have been inheritable, since in these prevailing parthenogenetic forms there is no chromatic reduction in the maturation of the egg and hence no segregation of characters is expected. If the eyeless condition of this individual were due to a mutation its descendants should have been eyeless, but un-

less the mutation occurred in a cell generation earlier than that in which the egg itself was differentiated no other germ cells of the parent or collaterals of the eyeless individual should bear the factor for eyelessness.

Observation of the occurrence of an eyeless mutant and the transmission of this characteristic would be of great interest as bearing upon the probable origin of eyeless cave animals. As is well known, many cave animals, particularly crustaceans, are without eyes or have extremely degenerate eyes.

It has been suggested that such cave forms may have arisen by "orthogenesis" (many small mutations) or, by implication, possibly by a single large mutation.[1]

Eyelessness in these forms is associated with lack of body pigment. Pigmentless animals, such as cave amphipods for example, may suffer deleterious effects if they come under the influence of the actinic rays of sunlight. Such animals are conspicuous and an easy prey to their natural enemies. In so far as a general vision may aid such organisms in reaching a suitable locality for securing food eyeless individuals are at a disadvantage in the open in competition with eyed individuals. On the other hand in caves and similar situations they are shielded from light, are not rendered conspicuous by their whiteness and are at no disadvantage in competition for food. It would seem that they have become segregated in caves and other retired situations because they can survive there and are unable to do so elsewhere.

The occurrence in *Drosophila* of a "bar-eyed" mutant (eye much reduced in size and in effective elements) and an "eyeless" mutant (in most cases not really eyeless but eyes more or less rudimentary) lends credence to the theory that eyeless cave animals, or such animals with very defective eyes, may have arisen as the result of mutations. One does not however lose sight of the fact that the eyeless daphnid mentioned may have arisen from a disturbance in development such as the writer has seen in eyeless salamander larvae and as have been found in other experimentally treated material. Of course in such cases one does not in general (Guyer's rabbits possibly form a notable exception) anticipate any degree of inheritance whatever, even if the abnormal individuals were viable and capable of producing young.

In the case of this eyeless daphnid however there were embryos in the brood chamber and there seemed every reason to believe that it possessed the normal capacity for producing young.

ARTHUR M. BANTA

[1] Banta, Carnegie Institution of Washington, Publication No. 67, 1907.

THE EASTER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY AT CHICAGO

THE sixteenth regular Western meeting of the American Mathematical Society was held at the University of Chicago on Friday and Saturday, March 25 and 26, 1921. The meetings were attended by over sixty persons, among whom were fifty-three members of the society.

The session of Friday afternoon was devoted to a lecture by Professor Dunham Jackson on "The general theory of approximation by polynomials and trigonometric sums."

It was voted at this meeting that the Christmas meeting of the Chicago Section be held in Toronto, in affiliation with the Convocation week meetings of the American Association for the Advancement of Science.

A dinner at which forty-seven persons were present was held at the Quadrangle Club on Friday evening.

At the sessions of Friday and Saturday forenoons, the following papers were presented:

1. I. J. Schwatt, "On the expansion of powers of trigonometric functions."
2. I. J. Schwatt, "On the summation of a trigonometric power series."
3. W. B. Ford, "A disputed point regarding the nature of the continuum."
4. Mayme I. Logsdon, "The equivalence of pairs of hermitian forms."
5. C. C. MacDuffee, "Invariants and vector covariants of linear algebras without the associative law."
6. E. J. Wilczynski, "Some projective generalizations of geodesics."
7. W. L. Hart, "Summable infinite determinants."

8. H. Blumberg, "New properties of all functions."
9. E. B. Van Vleck, "On non-loxodromic substitution groups in n dimensions."
10. G. A. Miller, "An overlooked infinite system of groups of order pq^2, p and q being prime numbers."
11. L. E. Dickson, "Fallacies and misconceptions in diophantine analysis."
12. L. E. Dickson, "A new method in diophantine analysis."
13. T. H. Hildebrandt, "On a general theory of functions—preliminary communication."
14. A. Dresden, "Some new formulæ in combinatory analysis."
15. J. B. Shaw, "Generational definition of linear associative hypernumbers."
16. J. B. Shaw, "On Hamiltonian products—Second paper."
17. F. E. Wood, "Congruences characterized by certain coincidences."
18. E. P. Lane, "A general theory of congruences."
19. J. Eiesland, "The group of motions of an Einstein space."

Professor Schwatt's papers were presented by Professor Dunham Jackson; Mr. MacDuffee was introduced to the society by Professor L. E. Dickson and Professor Wood by Professor Wilczynski; the papers of Professors Miller and Lane were read by title. Professor Bliss, president of the society, presided at the meeting of Friday afternoon. The other sessions were presided over by Professor R. D. Carmichael, chairman of the Chicago Section, relieved on Saturday by Professor Dunham Jackson, vice-president of the society.

ARNOLD DRESDEN,
Secretary of the Chicago Section

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PACIFIC DIVISION

1. REPORT OF THE SECRETARY-TREASURER FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1920

January 1, 1920, Cash balance		$524.72

Receipts

Received from the Permanent Secretary's office	$1,764.00	
Affiliated societies	115.00	
Dues and fees	272.00	$2,151.00
		$2,675.72

Expenditures

Dues remitted to Permanent Secretary's office	$141.00	
Supplies	18.00	
Salary, 1920	825.00	
Salary, 1919	75.00	
Office assistance	300.00	
Postage and express	37.67	
Telephone and telegraph	8.20	
Expense, general	5.40	
Expense, travel	208.50	
Printing	133.40	
Membership campaign	76.25	$1,828.42
January 1, 1921, Cash balance		$847.30

2. BALANCE SHEET, DECEMBER 31, 1920

Assets

Equipment	$235.73
Cash on hand	847.30
	$1,083.03

Liabilities

Permanent Secretary's office	$747.30
Investment (equipment)	235.73
Sundry creditors account	100.00
	$1,083.03

3. SUMMARY OF ANNUAL DISBURSEMENTS FOR THE YEAR 1920

Supplies	$18.00	
Salary	900.00	
Office assistance	300.00	
Postage and express	37.67	
Telephone and telegraph	8.20	
Expense, general	5.40	
Expense, travel	208.50	
Printing	133.40	
Membership campaign	76.25	$1,687.42

These disbursements have been made from funds derived as follows:

Affiliated societies (assessments)	115.00	
Initiation fees	163.00	
Receipts from the Permanent Secretary's office	1,409.42	$1,687.42

W. W. SARGEANT,
Secretary, Pacific Division

SCIENCE

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THE ELECTRON THEORY OF MAGNETISM[1]

Ever since the time of Faraday it has been known that all varieties of matter can be grouped in three classes on the basis of magnetic behavior, ferromagnetic, paramagnetic and diamagnetic.

It would be far too much to claim that the electron theory has as yet given anything like a complete account of the phenomena witnessed in connection with these three types of magnetism; but it is the only theory proposed which has been in any way satisfactory and which appears to hold out any hope for the future.

In accordance with the plans of this symposium I shall restrict myself to a consideration of the more general aspects of the theory and its simplest applications. For the sake of logical completeness I shall have to refer to many matters well known. The extension of the theory and its application to more special and complex cases, in so far as they can be handled on this occasion, will be treated by my colleagues.

The first electrical theory of ferromagnetism was proposed by Ampère just about one hundred years ago. On the basis of his own experiments on the behavior of electric circuits and magnets, and on the assumption, already justified, that magnetism is a molecular and not a molar phenomenon, he concluded that the molecule of iron is the seat of a permanent electrical whirl and thus essentially a permanent magnet with its axis perpendicular to the whirl. When the iron is fully magnetized, all the whirls are oriented alike, and

[1] A paper read as a part of the symposium on recent progress in magnetism held at the joint meeting of the American Association for the Advancement of Science, Section B, and the American Physical Society, December, 1920. Revised, January, 1921.

the magnetic moment of the mass of iron is the sum of the moments of the elementary molecular magnets. Ampère undoubtedly considered that in a neutral mass of iron the molecular magnets are turned indiscriminately in all directions, but he did not enter into any discussion of the process by which their axes are made parallel by the field during magnetization, nor did he consider the nature of the electrical whirls themselves.

Ampère was the grandfather of the electron theory of magnetism. Wilhelm Weber was its father. In 1852 Weber[2] published a paper in which he developed a theory which, slightly modified by Langevin,[3] is still perhaps the most widely accepted theory of diamagnetism, together with a theory of ferromagnetism which formed the starting point for the well-known theory of Ewing. Weber adopted the molecular whirls of Ampère, but assumed in addition that these whirls, always present in the molecules of magnetic substances, are also present in the molecules of diamagnetic substances when placed in a magnetic field. Further, he took the very important step of attributing mass or inertia to the electricity in the whirls, and he assumed that the electricity moves as if in fixed circular grooves in the molecule, so that each whirl maintains its diameter and its orientation with respect to the rest of the molecule as if rigidly constrained. According to Weber's conception, a substance is paramagnetic or ferromagnetic when the molecule, or magnetic element, contains a permanent whirl, with a definite magnetic moment, and so tends to set with its axis in the direction of any magnetic field in which it is placed; and a substance is diamagnetic when the molecule contains one or more frictionless grooves, with the mobile electricity at rest before the creation of the magnetic field. Langevin merely substitutes electrons moving in fixed orbits for Weber's electricity in grooves; and assumes that in a diamagnetic substance more than one orbit exists in the molecule and that the orbits are so constituted and grouped that the magnetic moment of the whole molecule is zero in a neutral field.

In this case, which we shall consider in some detail, the complete molecule will suffer no change of orientation when introduced into a magnetic field, but the speed of the electricity in each orbit or groove will change on account of the electromotive force around the orbit or groove due to the alteration of the extraneous magnetic flux through it. Its magnetic moment μ will thus increase (algebraically) by an amount $\Delta\mu$, which can readily be calculated. If e denotes the charge of electricity circulating in an orbit (whether as a single electron, or a ring of electrons, or a continuous ring), m the mass associated with the moving charge, r the radius of the orbit, H the intensity of the extraneous magnetic field, and θ the angle between the axis of the orbit and the direction of the field,

$$\Delta\mu = -\frac{e^2r^2H}{4m}\cdot\cos\theta. \qquad (1)$$

If we assume that there are N orbits per unit volume, all alike; and if we furthermore assume that all the orbits are perpendicular to the direction of the field (as they would be in the case of a saturated ferromagnetic substance) we get for the magnetic moment of unit volume, or the intensity of magnetization:

$$I = -\frac{e^2r^2NH}{4m} \qquad (2)$$

and for the susceptibility

$$K = I/H = -\frac{e^2r^2N}{4m}. \qquad (3)$$

If the orbits are not all perpendicular to the field intensity, but are uniformly distributed between all values of θ from 0 to π, as in an isotropic diamagnetic substance, we get instead of (3) the expression

$$K = -\frac{e^2r^2N}{12m}. \qquad (4)$$

If in this equation we substitute the value of e/m known for electrons in slow motion, and assume for a given substance such as bismuth values of N and r which appear to be reasonable from other physical evidence, we obtain from (4) values of K of the same order of magnitude as those found by experiment,

[2] W. Weber's Werke, III., p. 555.

[3] *Ann. chim. phys.* (8), 5, 1905, p. 70.

but the agreement is in general far from close. The equation requires that K should be independent of the temperature, unless e, m, r and N depend upon it. As is well known, the susceptibilities of many diamagnetic substances are independent of the temperature over wide ranges, while in other cases there is a marked dependence.

According to this theory also, effects of the same kind must exist in bodies which are ferromagnetic or paramagnetic superposed on effects of opposite sign, the resultant susceptibility being, as Larmor long ago pointed out, the sum of the two. The paramagnetic term may account for the variation of the resultant susceptibility with temperature in many diamagnetic bodies. From Weber's equation it may be shown that when $\theta = 0$

$$\frac{\Delta\mu}{\mu} = -\frac{eT}{m4\pi}H, \tag{5}$$

where T is the period of the orbit. If we assume that this period is that of sodium light, about 2×10^{-15} and that $H = 10^5$ (in excess of any intensity hitherto produced) (5) gives

$$\frac{\Delta\mu}{\mu} = -0.3 \times 10^{-3}, \tag{6}$$

so that the maximum diamagnetic effect is a very small part of the saturation effect in ferromagnetic substances. The fact that the intensity of magnetization of iron at saturation does not decrease appreciably even for great increases of intensity shows that $n = 1/T$ is very great.

From Weber's equations we may also calculate the change in frequency n of an orbit due to the magnetic field, and we find, after Langevin, but more generally,

$$\Delta n = -\frac{eH\cos\theta}{4\pi m}. \tag{7}$$

This may correspond in a way to the Zeeman effect in light, but gives a broad band instead of the sharp lines actually found, inasmuch as $\cos\theta$ has all values between -1 and $+1$.

It is unnecessary, however, to have recourse to electrons moving in orbits (or initially at rest and constrained to grooves) or to rotating electrified bodies, to explain the occurrence of diamagnetism, as has been shown by J. J. Thomson,[4] Voigt,[5] Lorentz,[6] and others, including very recently H. A. Wilson.[7] If a substance contains electrons either at rest or in plain rectilinear motion due to thermal agitation, and a magnetic field is created, an electrical intensity will evidently be developed with a curl equal to the negative rate of increase of the flux density, which will cause the electrons to move in paths curved in such a way as to produce a magnetic moment opposed to the direction of the applied field; and as the field becomes steady curvature will be maintained by the action of the field on the moving electrons normal to their velocities. Calculation on this hypothesis gives susceptibilities of the same order of magnitude as those given by the Weber-Langevin theory. This form of theory has the advantages over the other of greater freedom from assumptions and of giving, when applied to the optical case, a Zeeman effect with sharp lines. Weber does not attempt to justify his assumption that in a molecule the diameters of his orbital grooves remain constant, and that in a diamagnetic substance the grooves maintain their orientations independent of the applied magnetic intensity. With respect to the diameters, however, Langevin has shown that the magnetic field will produce no alteration provided the law of force is not precisely that of the inverse cube, which is quite improbable.

We shall return to the subject of diamagnetism later.

The first detailed theory of paramagnetism was given for perfect gases by Langevin in 1905.[3] Following Langevin, I shall begin with a gravitational analogue. Let us consider an enclosure containing a gas at uniform temperature and let us suppose the gravitational field anulled. The density of the gas will then be uniform throughout the enclosure. If now the uniform gravitational field is brought into action every particle of gas will receive an acceleration downward,

[4] Int. cong. phys., 1900, vol. 3, p. 138.

[5] *Ann. der Phys.* (4), 9, 1902, p. 130.

[6] "The Theory of Electrons," p. 124.

[7] *Roy. Soc. Proc. A*, 97, 1920, p. 321.

and the up and down velocities of the molecules will exceed the horizontal velocities, until after a short time involving many collisions, a redistribution, as required by the principle of equipartition, will have occurred, in which the component squared velocities are equalized and the whole mass of gas has a temperature greater than before. If D_0 denotes the density of the gas at the bottom of the enclosure, D the density at any height x, m the mass of one molecule, r the gas constant for one molecule, T the absolute temperature and g the acceleration of gravity, we have the relation

$$D/D_0 = e - \frac{w}{rT}, \tag{8}$$

in which $w = mgx$ is the work necessary to raise one molecule through the distance x against gravity.

Now suppose each molecule to have a magnetic moment μ and imagine a vertical magnetic field applied throughout the enclosure instead of the gravitational field. The molecules will be driven to set themselves with their magnetic axes parallel to the magnetic intensity just as before the molecules were driven downward, and rotational velocities about lines normal to the field intensity will be favored, but thermal agitation will redistribute them as before until the law of equipartition is satisfied. If now θ denotes the angle made by the axis of any molecular magnet with the (vertical) magnetic intensity H, ρ the number of molecules per unit volume with their axes between θ and $\theta + d\theta$, and ρ_0 the number between 0 and $d\theta$, we have, by strict analogy with the gravitational case,

$$\rho/\rho_0 = e - \frac{mH\,(1 - \cos\theta)}{rT}. \tag{9}$$

Starting from this formula we can readily calculate the total change produced in the magnetic moment of the gas (0 before the application of the field) and thus the intensity of magnetization I. If a is written for

$$\frac{mH}{rT} \tag{10}$$

we get the expression

$$I = N\mu\left\{\frac{e^a + e^{-a}}{e^a - e^{-a}} - \frac{1}{a}\right\}, \tag{11}$$

where N = the number of molecules per unit volume.

When a is small, as it is except for very intense fields and very low temperatures, this equation becomes, with negligible error,

$$I = N\mu\cdot\frac{1}{3a} = \frac{N\mu^2}{3rT}\cdot H, \tag{12}$$

which gives for the susceptibility

$$K = I/H = \frac{N\mu^2}{3rT}. \tag{13}$$

The susceptibility is thus independent of H, and inversely proportional to T. So far as temperature is concerned it expresses the law of Curie, which holds for the paramagnetic gas oxygen over a great range of temperatures, and which holds over a great range in many other cases in which the molecular magnets are so far apart as not to act appreciably on one another.

Inasmuch as r is known, and as N is known for any value of T at known pressure, we can calculate μ from the observed value of K. We thus obtain for oxygen, reckoning from 0° C. and 760 mm. pressure,

$$\mu = \sqrt{\frac{3rTK}{N}} = 2.5 \times 10^{-20}. \tag{14}$$

Langevin's theory of paramagnetism is not an electron theory, as it has been developed without regard to the permanent electrical rotations assumed on this theory to account for the permanent magnetic moment of the elementary magnet. Nevertheless, it has rendered great services and has important relations to the electron theory.

Investigation of the behavior of *free* electron orbits, as distinguished from the fixed orbits of Weber, in a magnetic field, have been made by Voigt[5] and J. J. Thomson,[8] who independently, in 1902 and 1903, reached the conclusion that the existence, without damping, of such orbits in a substance would give it neither diamagnetic nor paramagnetic properties. The diamagnetic effects arising from change of velocities produced by the magnetic intensity are just balanced by the paramagnetic effects due to the change of orbital orientation. With suitable dissipation

[8] *Phil. Mag.* (6), 6, 1903, p. 673.

of energy, however, Thomson has concluded that paramagnetism may result, and Voigt that either paramagnetism or diamagnetism may result, according to circumstances. But the conceptions they have presented of the manner in which these results may be brought about do not seem probable, and have not gained wide acceptance.

Voigt and, after him, Lorentz and Gans,[9] have examined the behavior in a magnetic field of magnetic elements, or magnetons, consisting of homogeneous uniformly charged solids or symmetrical electron systems, in rotation, and have reached interesting and important conclusions.

One of the most important cases is that of a magneton which may be treated as a solid of revolution, with initial angular velocity greater than $eH/2m$ about the unique axis. In this case in accordance with classical electromagnetic theory, the rotation proceeds undamped about the unique axis, while it is damped about the other (equal) axes, and the action of the field on the magneton is as follows: When the field is applied, precession of the magneton's axis about the direction of the field begins, accompanied by nutation. The nutation is damped out by dissipation or radiation, and the precession is retarded for the same reason. Hence the direction of the axis of the magneton gradually approaches coincidence with the direction of the field, when it is in stable equilibrium. During this process the velocity of rotation diminishes slightly, the motion being affected as in the case of the electricity in Weber's molecular grooves.

If there are N such magnetons in the unit of volume, and if the demagnetizing and molecular fields and the upsetting effect of collisions are negligible, all the magnetons will ultimately become oriented with their axes in the direction of the magnetic field. In this case the moment of unit volume will be

$$I = \frac{eNC}{2m}\left(u - \frac{eH}{2m}\right), \qquad (15)$$

when e is the charge of the magneton, C its moment of inertia about the axis of permanent rotation, u its angular velocity about this axis, and H the intensity of the applied field.

The first and principal term is entirely independent of H. The orientation is, of course, produced by the magnetic field, but only the time taken to arrive at the steady state is affected by its magnitude. The second term is a diamagnetic term, and arises from the fact that owing to the change of flux through the magneton during the process of its orientation its velocity is decreased, just as in the case of the Weber-Langevin theory.

In this case we have, except for the small diamagnetic term, which vanishes with the intensity, saturation for even the weakest fields; and we have less nearly complete saturation for stronger fields.

When collisions are not absent, a magneton's axis will be repeatedly deflected in its approach toward coincidence with the direction of the field, and the intensity of magnetization will not reach saturation; but it will increase with the field strength, being greater for a given field strength, the greater the mean time between collisions and the weaker the molecular and demagnetizing fields. Increase of temperature, shortening this time between collisions, and increasing their violence, will, if the magnetons remain unchanged, thus diminish the magnetization for a given field strength.

The precessional process described above is doubtless similar in a general way to the process by which in every case in paramagnetic and ferromagnetic substances the magnetons are aligned more or less completely with the magnetic field.

The exceedingly interesting ring electron recently proposed by A. L. Parson and extensively applied by him and others to a wide range of chemical and physical phenomena, is a special case of Voigt's magneton, and will be discussed by one of my colleagues.

Bearing in mind that, on the electron theory, the molecule or magneton must, with Voigt, be treated as a gyroscope and can not

[9] *Gött. Nachr.*, 1910, p. 197.

execute true rotations,[10] such as Langevin assumed, except as very special cases of precession, Gans[11] has recently developed a general theory of diamagnetism and paramagnetism, proceeding in accordance with the methods of statistical mechanics. He assumes as his magneton a body rigidly built of negative electrons and placed inside a uniformly and positively charged sphere whose center is coincident with the center of mass of the electrons, and whose charge is equal in magnitude to that of the magneton, so that electrical actions do not have to be considered. The energy is assumed to be entirely electromagnetic.

For simplicity it is assumed that two of the principal (electromagnetic) moments of inertia are equal, but it is not assumed in general that the magneton is a body of revolution; thus the cross-section normal to the unique axis might be a square, and rotation about it subject to the effects of thermal collisions, instead of a circle, with rotation independent of such collisions.

The method of statistical mechanics is then applied to the two cases to be considered: first, that in which the magneton is not a body of revolution so that the rotations about the three axes must all be treated as statistical coordinates; and second, that in which the magneton is a body of revolution so that rotation about the axis of figure is not affected by collisions and can not be treated as a statistical coordinate.

In the first case it is found that the susceptibility is always negative, or the substance diamagnetic.

When the three principal moments of inertia are equal, the susceptibility is independent of the temperature and of the intensity of the magnetic field, which is the case with many diamagnetic substances.

When but two of the moments are equal, however, the susceptibility depends on both the temperature and the intensity in somewhat complicated ways. Fig. 1 shows the general relation between the susceptibility and the intensity according to Gans's theory, while Fig. 2 shows the type of curve found experimentally by Honda in many cases. The importance of carrying the measurements down

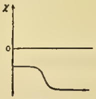

Fig. 1.

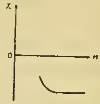

Fig. 2.

into weaker fields is manifest; and this has recently been done for bismuth and antimony by Isnardi and Gans,[12] who, working with pure materials, find no dependence on the field strength. As Honda suggests, the dependence on intensity suggested by his curves is probably due to the presence of iron, whose positive susceptibility, opposing that of the diamagnetic substances, decreases with increasing magnetic intensity. Curves obtained by Honda and Owen, and by Isnardi and Gans, are shown in Fig. 3.

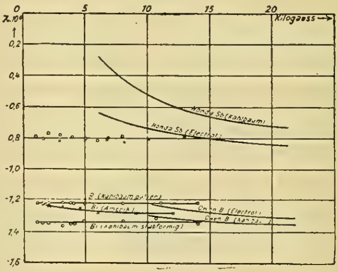

Fig. 3.

Fig. 4 shows the way in which, according to the theory, the susceptibility χ depends upon the absolute temperature θ, while the type of curve found in Honda's experiments is shown in Fig. 5. Little weight can be given the lower part of the theoretical curve, inasmuch as equipartition of energy and also absence of inter-molecular action were both assumed in its derivation, and it is improbable

[10] See also F. Krueger, *Ann. der Phys.* (4), 50, 1916, p. 364.

[11] *Ann. der Phys.* (4), 49, 1916, p. 149.

[12] *Ann. der Phys.* (4), 61, 1920, p. 585.

that either is true at low temperatures. There is a general agreement between theory and experiment. The trend of the experimental

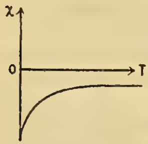

FIG. 4.

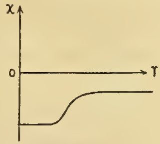

FIG. 5.

curve can not be explained by the presence of iron, as the positive susceptibility of the iron would become less with temperature increase.

We come now to the second case, in which the magneton has a true axis of figure and an essentially permanent angular momentum about this axis, and therefore a magnetic moment in the direction of this axis, unchangeable by collisions. On account of this permanent magnetic moment and angular momentum, paramagnetism results very much as in the theory of Voigt already presented; and on account of the slight diminution of this angular momentum in the magnetic field and on account of the rotation of the magneton about the other axes brought about or modified by the thermal agitation in accordance with the law of equipartition, diamagnetism results and is superposed upon the paramagnetism.

This diamagnetism does not appear in Langevin's theory, because instead of a permanently rotating magneton he assumed a permanent magnet without angular momentum about the axis except as produced by thermal collisions. Langevin, however, assumed that Weber's diamagnetism was superposed upon the paramagnetism, and this corresponds in part to the diamagnetism of Gans's theory.

Returning to the results of Gans's statistical treatment for the case of the magneton in permanent rotation about a unique axis, we find that the susceptibility is a function of both field strength and temperature. It may even be positive at lower intensities or temperatures, and negative at higher.

Isothermals for different temperatures θ between the susceptibility G and the magnetic intensity h are shown in Fig. 6, and isodynamics for different intensities h between the susceptibility G and the temperature θ are

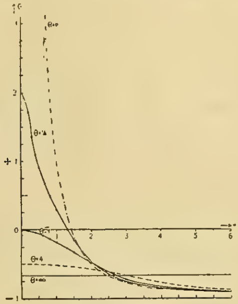

FIG. 6.

shown in Fig. 7. Thus while diamagnetism may exist without paramagnetism, paramagnetism is always accompanied by diamagnetism, as on all other theories. In weak fields and at low temperatures the paramagnetism may prevail; but as the temperature and field strength increase it goes over into diamagnetism.

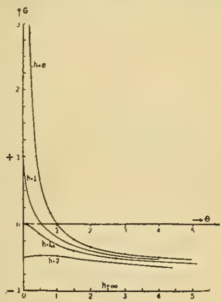

FIG. 7.

A transition from paramagnetic to diamagnetic susceptibility, whatever may be the ex-

planation, has been observed by Weber and Overbeck[13] in the case of copper-zinc alloys, and by Honda in the case of indium. Weber and Overbeck, who have taken great precautions and believe their alloys free from iron, have called the phenomenon *metamagnetism*. The downward trend of paramagnetic susceptibility with increase of field strength is apparent in some of the curves obtained by Honda.

For weak fields at low temperatures, but with H/T finite, Gans's formula approaches that of Langevin as a limit. Here the paramagnetic rotations are prominent in comparison with diamagnetic thermal rotations about the other axes. As the field intensity approaches zero with finite values of the temperature the susceptibility approaches a limit which is the sum of two terms, a paramagnetic term identical with that of Langevin and a diamagnetic term independent of the temperature like that of Weber.

The theory of Gans thus covers a wide range of cases, but so far has been applied in detail to but few. By taking account of the molecular field, and by applying the quantum theory, although not in the most thorough way, he has more recently extended his theory to cover more accurately the paramagnetism exhibited by dense bodies and at low temperatures.[14] In a similar way the quantum theory has been set into the theory of Langevin by Oesterhuis[15] and Keesom[16]; and it has been thoroughly applied, for the case of rotation with one degree of freedom, by Weyssenhoff,[17] and for the case of rotation with two degrees of freedom by Reiche[18] and by Rotzajn,[19] to the system of elementary magnets, without permanent angular momentum, assumed by Langevin. These theories are thus not electron theories, like that of Gans. They reduce to the theory of Langevin at high temperatures when equipartition exists, and the rigorous theories agree well with experimental results obtained at low temperatures, where Langevin's theory completely fails. The next step should be the rigorous application of the quantum theory to the case in which the magneton has a permanent angular momentum, with gyroscopic properties, as required by the electron theory.

According to experiment hydrogen and helium are diamagnetic although according to Bohr's models their molecules have strong magnetic moments. This is apparently consistent with the theory of Gans, but inconsistent with the theory of Weber and Langevin. Honda and Okubo,[20] in a part of a paper dealing more generally with the kinetic theory of magnetism, have proposed the following explanation of this diamagnetic effect. Suppose the magnetic axis to be rotating about one of the other axes in a plane parallel to the magnetic intensity. On account of the presence of the field, the velocity of rotation, which would be uniform without the field, is now variable, the motion being more rapid when the moment points in the direction of the field than when it points the other way. Hence the time mean of its directions is opposite to that of the field and the mean effect is diamagnetic. If the magnetic axis is rotating in a plane not parallel to the direction of the field, we must resolve the effect in the direction of the field. Doing this for all the elementary magnets, originally pointing uniformly in all directions, we get a resultant diamagnetic effect. This, however, is only a part of the total effect found in Langevin's theory to be paramagnetic, though it is only implicit in his treatment, unless we assume *permanent* rotations, independent of the temperature, about an axis normal to the magnetic axis. This assumption they have made.

From what we have seen there seems to be no way to account satisfactorily for paramagnetism and ferromagnetism except on the assumption of an elementary magnet which is a permanent electrical whirl, as Ampère assumed; which has also mass, as Weber as-

13 *Ann. der Phys.* (4), 46, 1915, p. 677.

14 *Ann. der Phys.* (4), 50, 1916, p. 163.

15 *Phys. Zeit.*, 14, 1913, p. 862

16 *Phys. Zeit.*, 15, 1914, p. 8.

17 *Ann. der Phys.* (4), 51, 1916, p. 285.

18 *Ann. der Phys.* (4), 54, 1917, p. 401.

19 *Ann. der Phys.* (4), 57, 1918, p. 81.

20 *Phys. Rev.*, 13, 1919, p. 6.

sumed; and which has therefore the dynamical properties of a gyroscope. It will now be shown how these gyroscopic properties have made possible a complete and direct demonstration of the correctness of this theory.

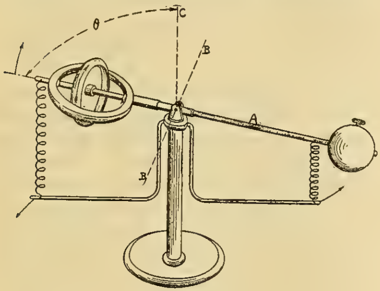

Fig. 8.

In Fig. 8 is shown a gyroscope whose wheel, pivoted in a frame, can be rotated rapidly about its axis A. Except for the action of two springs, the frame and the axis A are free to move in altitude about a horizontal axis B, making an angle θ with the vertical C; and the axis B and the whole instrument can be rotated about the vertical axis C. If the wheel is spun about the axis A, and the instrument then rotated about the vertical C, the wheel tips up or down so as to make the direction of its rotation coincide more nearly with the direction of the impressed rotation about the vertical axis C. If it were not for the springs, the wheel would tip until the axes A and C became coincident. The greater the rotary speed about the vertical the greater is the tip of the wheel. When the wheel's speed about the axis A is zero, no tip occurs.

Now if the magnetic molecule is a gyroscope, it will behave like this wheel. If the body of which it is a part is set into rotation about any axis, the molecule, or magneton, will change its orientation in such a way as to make its direction of rotation coincide more nearly with the direction of the impressed rotation; the coincidence will finally become exact if this is not prevented by the action of the rest of the body. This idea was in the mind of Maxwell in 1861, and has occurred to a number of others since.

In an ordinary ferromagnetic body in the usual state with which we are familiar only a slight change of orientation can occur on accunt of the forces due to adjacent molecules, which perform the function of the springs in the case of our gyroscope. The rotation causes each molecule to contribute a minute angular momentum, and thus also a minute magnetic moment, parallel to the axis of impressed rotation; and thus the body, whose magnetons originally pointed in all directions equally, becomes magnetized along the axis of impressed rotation. If the revolving electrons, or rotating magnetons, are all positive, the body will thus become magnetized in the direction in which it would be magnetized by an electric current flowing around it in the direction of the angular velocity imparted to it. If they are all negative, or if the action on the negative magnetons is preponderant, it will be magnetized in the opposite direction.

If R denotes the ratio of the angular momentum of a magneton, or an electron orbit, to its magnetic moment, it can readily be shown that rotating a magneton or electron orbit about any axis with an impressed velocity N revolutions per second, is equivalent to placing it in a magnetic field with intensity H directed along this axis such that

$$H = R 2\pi N.$$

If the electric density is proportional to the mass density throughout the volume of the magneton this ratio is easily shown to be $R = 2m/e$; so that in this case

$$H = 4\pi \frac{m}{e} N. \tag{16}$$

If all the magnetons in a body are alike, therefore, rotating it at an angular velocity of N r.p.s. will produce the same intensity of magnetization in it as placing it in a field of strength $4\pi(m/e)N$ gausses.

For negative electrons of the ordinary type $4\pi(m/e) = -7.1 \times 10^{-7}$ e.m.u. according to well-known experiments. Hence, if orbital motions of these electrons are responsible for the magnetism of ferromagnetic substances, rotating them at a velocity of N revolutions

per second should magnetize them as would a field of intensity

$$H = -7.1 \times 10^{-7} N \text{ gauss.} \tag{17}$$

Now in two investigations on cold-rolled steel by a method of electromagnetic induction, a third investigation principally on steel, nickel and cobalt by a magnetometer method, and a fourth investigation on steel, soft iron, cobalt, and Heusler alloy by another magnetometer method, Mrs. Barnett and I have found the above theory verified, except that in place of the number 7.1 we find smaller numbers; in the best work, which appears to be free from any serious systematic error, we find instead of 7.1 numbers about one half as great and even smaller.[21] This work, however, is still in progress.

If these results are correct, we seem to be driven to one of two conclusions: Either negative electrons or magnetons with a value of m/e or R for the motions involved different from that ordinarily accepted are responsible for magnetism; or positive electrons or magnetons, whose rotation we have seen must produce an opposite effect, are also involved. It does not seem impossible that a ring or other type of negative magneton, with R different for the permanent rotary motion from the value obtained from cathode ray experiments and otherwise, should be involved; but the presence of positive electron orbits, or rotating positive magnetons, is also possible, especially in view of the known expulsion of α particles with great velocities from the radioactive substances. Chemical evidence is often quoted in favor of the idea that superficial negative electrons alone are responsible for magnetism; but I do not think this evidence conclusive.

Not long after our first conclusive experiments on magnetization by rotation were communicated to this society, experiments on the converse effect, viz., rotation by magnetization, first suggested by Richardson, were performed by Einstein and deHaas.[22] Magnetizing a bar of iron, in turning the magnetons about until they all rotate in the same direction, produces angular momentum in this direction which must be compensated by an angular momentum within the molecules themselves, or in the bar, or in the magnetizing solenoid. If we assume that the reactions all take place upon the bar we can calculate $4\pi(m/e)$ from the measurable angular momentum communicated to it when magnetized to a given intensity on the assumption that all the magnetons are alike. The result published by Einstein and deHaas agreed closely with the value to be expected on the hypothesis that only the common type of negative electron is involved; but the sign of the effect was not determined with certainty till much later, and errors in the value of the assumed intensity of magnetization and in the experiments themselves undoubtedly exist. The experiments have been repeated with great improvements by Emil Beck,[23] and experiments on the same subject but by a different method had already been made by J. Q. Stewart;[24] both these investigations, on the basis of a single kind of electron and on the assumption made above with reference to the seat of the reaction to the electron momentum, give values of $4\pi(m/e)$ for iron and nickel similar to those which Mrs. Barnett and I have found by the method of magnetization by rotation, into the theory of which no assumptions appear to enter except such as can be justified completely.

If a magneton is sufficiently free it will, as stated above, when rotated about a given axis align itself with its axis completely parallel to the axis of impressed rotation. If in the unit volume there are N magnetons all alike, each with the moment of inertia C and initial angular velocity U about the magnetic axis, and if the effects of collisions and the demagnetizing field are negligible, the intensity of magnetization will be

$$I = \frac{NCe}{2m}(U + \Omega). \tag{18}$$

The first term is independent of Ω, which is a measure of the intrinsic intensity of rota-

[21] *Phys. Rev.*, 6, 1915, p. 239; 10, 1917, p. 7; *Proc. American Phys. Soc.* for December, 1920; *Proc. Phil. Soc. of Washington* for October 9, 1920.

[22] *Verh. d. D. Phys. Ges.*, 17, 1915, p. 152.

[23] *Ann. der Phys.* (4), 60, 1919, p. 109.

[24] *Phys. Rev.* (2), 11, 1918, p. 100.

tion, just as, in Voigt's equation, the first term is independent of H. The orientation is here produced by the rotation, but only the time taken to reach a steady state is affected by its magnitude. The second term, here added to the first, corresponds to Voigt's diamagnetic term. Here we have, except for the small second term, saturation for even very small values of Ω.

If collisions are not absent, or if the magnetic fields of adjacent molecules and the demagnetizing field become appreciable, the intensity of magnetization will not reach saturation; but it will increase with Ω, being greater for a given value of Ω the greater the mean interval between collisions, the less their violence, and the weaker the field.

It was suggested by Schuster in 1912 and by Einstein and deHaas in 1915, and earlier by myself, that the behavior of a magnetic molecule as a gyroscope might account for cosmical magnetism, as the direction of the magnetization of the earth and sun bear to the direction of the rotation the relation required by the theory. If the theory is quantitively sufficient, the interior of the earth and sun, as pointed out years ago, must be in a very different state from that of bodies with which we are familiar. If m/e reaches enormous values for magnetons within the earth and sun, which is not probable, or if the magneton density is sufficiently high and the effects of collisions and the molecular and demagnetizing fields at the same time sufficiently small, it is possible that even the small angular velocities of the earth and sun may be sufficient to produce the observed magnetizations.[25]

S. J. Barnett

Department of Terrestrial Magnetism,
Carnegie Institution

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SPRING MEETING OF THE EXECUTIVE COMMITTEE

The executive committee of the council of the association held its regular spring meeting in the Cosmos Club, Washington, D. C., on the afternoon and evening of Sunday, April 24. The following paragraphs summarize items of business that were transacted. The personnel of the executive committee is as follows:

Simon Flexner (chairman), J. McK. Cattell, H. L. Fairchild, L. O. Howard, W. J. Humphreys, B. E. Livingston (permanent secretary of the association), D. T. MacDougal (general secretary of the association), E. H. Moore (president of the association), A. A. Noyes, Herbert Osborn, H. B. Ward. All of the members were present at this meeting, excepting Messrs. Flexner, Moore, and Noyes. The meeting was called at 4.00 P.M.

After the minutes of the last meeting of this committee (Chicago, Dec. 29, 1920) had been read and approved it was voted that the next meeting of the executive committee "shall occur in New York City on the first Sunday after November 1 that shall be convenient to a majority of the members," the exact date to be arranged by the permanent secretary.

It was voted that the action thus far taken by the American Association committee on conservation, be approved and that that committee be authorized to proceed with its plans. (The committee on conservation consists of J. C. Merriam (chairman), H. S. Graves, Barrington Moore, V. E. Shelford and Isaiah Bowman. It held a meeting in New York City on April 9, jointly with corresponding committees of the National Academy of Sciences and the National Research Council, and it was recommended that these three committees form a continuing joint committee on national conservation, representing the three organizations just mentioned, and that this joint committee be authorized to set up an executive and secretarial agency for the active prosecution of its work.)

The executive committee ratified the action taken by the committee on honorary life memberships through the Jane M. Smith fund, in placing the names of the distinguished scientists, J. E. Clark and J. N. Stockwell, recently deceased, on the list of honorary life members of the Association. (Both were ac-

25 See papers by Professor S. Chapman and by myself in *Nature*, Nov. 25, 1920, and March 3, 1921.

tive members of the Association from 1875 until death.)

Dr. J. C. Fields, president of the Royal Canadian Institute, was elected chairman of the local committee of the American Association, for the forthcoming Toronto meeting.

Dr. Sam F. Trelease (assistant secretary of the association) was elected secretary of the council for the Toronto meeting.

It was voted that a special committee consisting of the president, the permanent secretary, and the general secretary should arrange, in cooperation with the local committee for the Toronto meeting, for the invitation of an eminent British man of science to attend the Toronto meeting, to give a general public lecture on the evening of Friday, December 30, and to present such scientific papers as he may be willing to give, before the section of the association or the affiliated societies to which his field of science may be related.

It was voted that the British Association for the Advancement of Science be invited to be officially represented at the Toronto meeting. A committee consisting of the president and the two secretaries was authorized to invite representation by other organizations at the Toronto meeting. Dr. J. McK. Cattell was elected to be an official delegate of the American Association to attend the forthcoming Edinborough meeting of the British Association. The committee mentioned was authorized to appoint other representatives.

It was voted that the permanent secretary and the general secretary be constituted a special committee to render a decision in the case of any fellowship nomination for which the section secretary may fail to make definite recommendation. (Nominations for fellowship in the Association may be made by any member in good standing, including the nominee himself, and they are immediately referred, by the permanent secretary, to the proper section secretary, who investigates each nomination and transmits it, with his recommendation to the permanent secretary for reference to the executive committee. The executive committee acts for the council in electing fellows at the spring and autumn meetings of the committee and it recommends fellowship elections to the council when a council session follows promptly upon the committee meeting—as during the annual meetings of the association. Only fellows may hold office in the association and fellows are designated by an asterisk in the list of members.)

The American Society for Testing Materials (C. L. Warwick, secretary, 1315 Spruce Street, Philadelphia, Pa.) was constituted an affiliated society. (The membership of the society includes 62 fellows of the association and the society is therefore entitled to one representative in the association council.)

The American Society of Agronomy (P. E. Brown, secretary, Iowa State College, Ames, Iowa) was constituted an affiliated society. (The membership of the society includes 93 fellows of the association and the society is therefore entitled to one representative in the association council.)

The American Geographical Society of New York (Isaiah Bowman, director, Broadway at 156th Street, New York City) was constituted an affiliated society.

The North Carolina Academy of Science (Z. P. Metcalf, president, North Carolina Experiment Station, West Raleigh, N. C.) was constituted an affiliated academy, according to the special arrangement for the affiliation of academies. (Affiliated academies collect the association dues of those of their members who are also members of the association. They each have a representative in the association council and they are allowed to retain the entrance fees collected and one dollar of each annual dues collected. When an academy is first affiliated it receives from the association one dollar for each one of its members that have already paid to the permanent secretary association dues for the current year.)

The Maryland Academy of Sciences was constituted an affiliated academy, according to the special arrangement just mentioned.

Professor T. W. Todd, professor of anatomy, Western Reserve University, Cleveland, Ohio, was elected a member of the section committee

of Section H (Anthropology), to take the place of Dr. Berthold Laufer, resigned from the association. (The new committee member's term of office expires at the end of the 1924–25 annual meeting.)

A special committee, consisting of J. McK. Cattell (chairman), L. O. Howard, D. T. MacDougal, and B. E. Livingston, was appointed to arrange for sections C, K, L, M, and N at the Toronto meeting, this committee to coöperate with the corresponding section committees in so far as their members have been elected. It was voted that this committee should organize a committee of seven members for each of the three fields, (*a*) Social and Economic Sciences, (*b*) Engineering, and (*c*) Medical Sciences, each of these three committees to survey the general relations between the association and the committee's province, with the aim of securing more satisfactory representation of that field of science in the work of the association. It was recommended that the membership of these three committees include eminent scientists without regard to their membership in the association, the permanent secretary and at least one other member of the association being on each.

The question regarding the organization of the History of Science was again given careful consideration by the executive committee. The special committee that arranged the excellent program on this subject for the Chicago meeting has expressed itself as in favor of the History of Science being made the field of a new section of the association, but the consideration that this field overlaps the fields of the already existing sections has prevented the executive committee from concurring with the special committee on this point. The council of the association (at its Chicago meeting) favored the organization of the History of Science as a part of Section L (Historical and Philological Sciences), not yet organized, but the special committee does not favor this arrangement. The executive committee finally concluded to suggest that a special society for the History of Science might be inaugurated and that this society might become an affiliated society of the association.

At the suggestion of the American Society of Zoologists, a resolution was adopted favoring the duty-free importation of scientific materials into the United States by educational and research institutions.

The executive committee expressed its regret that, owing to lack of funds, the association found it impossible to comply with a suggestion recently received from the Hall of Fame of New York University, that the association provide a bust of an eminent scientist for the Hall of Fame. Upon invitation from the chancellor, the council and the committee on the Hall of Fame of New York University, three delegates were appointed to represent the Association on the occasion of the unveiling of a tablet in honor of Louis Agassiz—a past president of the Association—this ceremony to occur in the colonnade of the Hall of Fame, at University Heights, New York City, on May 21, 1921. Messrs. C. B. Davenport, H. F. Osborn, and E. B. Wilson were appointed.

A proposal to establish a section on the Evolution of Religion and Philosophy was given consideration and it was voted that, "since the subjects referred to are already provided for by existing sections of the Association, it seems unnecessary to inaugurate a special section for them at this time."

Four new items were approved for the permanent secreary's budget for 1921, these having been omitted from the budget as approved by the council at the Chicago meeting. A statement of the entire budget follows:

Permanent Secretary's Budget for 1921.

Items approved by the Council at the Chicago Meeting:

Journals	$36,000.00
Salaries:	
Permanent secretary	2,500.00
Executive assistant	2,520.00
Usual clerical help	2,000.00
Special clerical help for new membership list	800.00
Travel expenses, section secretaries, etc.	1,500.00
Office supplies	800.00
Stationery and printing	2,400.00

Telephone, etc.	100.00
Postage	800.00
Expenses of Chicago meeting	1,000.00
Membership list, printing (balance not provided by sale of list)	1,000.00
Miscellaneous	500.00
Benjamin collection of portraits and autographs of Association presidents	300.00
Total approved at Chicago	$52,220.00

Additional items approved by Executive Committee April 24, 1921:

Dollar payments to divisions and dollar allowances to affiliated academies (according to rules of procedure)	$ 2,400.00
Printing and mailing (to all members) the Preliminary Announcement of Chicago meeting	955.36
Grant for research (arranged for by Committee on Grants but not covered by appropriable funds in the treasurer's hands at end of 1920; approved by Executive Committee, March 7, 1921)	500.00
Salary, assistant secretary (authorized by Council at Chicago meeting)	1,000.00
Total, additional items	$ 4,855.36
Total of modified budget	$57,075.36

The executive committee expressed itself as interested in the work for the advancement of science accomplished through the grants thus far made for research and the permanent secretary was instructed to communicate with the committee on grants and to arrange with that committee for the preparation of a general report on grants for research made by the Association from year to year.

The permanent secretary presented a report on the affairs of the Association, a summary of which will appear in a later issue of SCIENCE.

The general secretary presented a report considering the following items: (*a*) The supplying of the past publications of the Association to scientific institutions outside of the United States. (*b*) The committee on Mexican scientific organization (see SCIENCE, N. S., 53: 4, 1921) is active and the work is in progress. (*c*) The general secretary is making a study of the problem of securing a fuller attendance of members of the council at council meetings.

A campaign for new members, especially among residents of Canada, was authorized, with special reference to preparations for the Toronto meeting. It was recommended that the medical men of the United States be specially invited to join the association.

It was voted that the edition of the new volume of the Summarized Proceedings of the association should include (*a*) the number of copies ordered and paid for in advance at the time of printing (over 1,600 copies were thus accounted for on April 23) and (*b*) an extra supply of 500 copies. The permanent secretary was authorized to distribute not over 50 copies gratis, to a selected list of libraries, etc., throughout the world. (The volume, including the Membership List, will appear about June 1. It may be purchased by members of the association for $1.50 if payment be made in advance of the final going to press; the price to non-members is $2.00.) It was voted that the price of the 1921 volume of Summarized Proceedings, including the Membership List, should be $2.00 to members and $2.50 to non-members, after the date of publication.

It was voted that the association would welcome an address, at the Toronto meeting, under the auspices of the Society of Sigma Xi, an affiliated society of the Association.

The committee adjourned at 10.05, to meet in New York City early in November.

BURTON E. LIVINGSTON,
Permanent Secretary.

MEDALS OF THE NATIONAL ACADEMY OF SCIENCES

AT the annual dinner of the Academy held at the Hotel Powhatan on April 26, a surprise was sprung upon the president, Dr. Charles D. Walcott, when Dr. W. H. Welch took the chair and introduced Dr. J. M. Clarke of the State Museum, Albany, New York, who out-

lined the scientific career of Dr. Walcott and announced that the committee had selected him as the first recipient of the Mary Clark Thompson Gold Medal for "eminence in geology and paleontology." Dr. Walcott in responding told how his attention had been attracted as a boy to the trilobites in the rocks near the old swimming hole and how he had pursued the study of these fossils with peculiar interest to the present day, for his paper read before the academy in its session that afternoon dealt with the structure of these trilobites.

In awarding the Agassiz medal President Walcott told of the desire expressed by Sir John Murray, on his visit to this country, to leave a fund to commemorate Alexander Agassiz, which took the form of the Agassiz Gold Medal for "original contributions to the science of oceanography." The medal for 1918 was awarded to His Serene Highness, Albert I., Prince of Monaco, the guest of the evening.

Dr. W. H. Dall of the Smithsonian Institution, described the scientific researches of the Prince of Monaco in the investigation of ocean currents and ocean life, including voyages in his especially equipped yachts from the Azores to the Arctic. The Prince founded at Monaco the Museum of Oceanography; later at Paris the Institute of Oceanography, and last December opened at Paris the Institute for Human Paleontology.

The Prince in reply said he had never expected that the work he had done with such pleasure would lead to the great honor he had now received. This honor, he said, should be shared with the companions who have worked for thirty-five years with him on board ship and in the laboratories. The Prince expressed the high regard which he has always held for the American people and for the political conditions which gave an opportunity for the reward of honest labor not to be matched elsewhere in the world.

President Walcott next announced the award of the Henry Draper medal to Dr. P. Zeeman of Amsterdam, Holland. Dr. C. G. Abbot read a letter from Dr. William W. Campbell, of the Lick Observatory, explaining the importance of the work of Zeeman in demonstrating the doubling and tripling of the lines of the spectrum in a magnetic field twenty-five years ago. Dr. Abbot pointed out that by the study of the Zeeman effect Dr. George E. Hale, of the Mount Wilson Observatory, had been enabled to map the magnetic field of the sun spots and to show that the sun itself is a magnet. This led to the discoveries in spectroscopy announced by Dr. Hale at the present session of the Academy.

In the absence of Professor Zeeman the medal was received in his behalf by the Secretary of the Legation of the Netherlands.

Dr. Henry Fairfield Osborn of the American Museum of Natural History, New York, gave a sketch of the life and work of Dr. Robert Ridgway to whom was awarded the Daniel Giraud Elliot Gold Medal for his studies in American Ornithology. Dr. Ridgway was born in Cromwell, Illinois, and at the age of fourteen discovered his first new bird. This brought him to the attention of Professor Baird. At seventeen he became a member of the Clarence King Survey of the west. Ridgway's "Birds of Northern and Middle America" is the most exhaustive and complete treatise on birds of any region in the world. A letter was read from Dr. Ridgway in which he paid high tribute to Daniel Giraud Elliot as his inspiration and example.

The Alexander Agassiz gold medal for 1920 was awarded to Rear Admiral C. G. Sigsbee, U.S.N., retired, who was assigned to hydrographic work in 1874 and carried out on the *Blake* a remarkable series of explorations in the Gulf of Mexico on new methods of deep sea sounding and temperature reading. Admiral Sigsbee not being present, the medal was received in his behalf by Rear Admiral Taylor, who read a letter from Admiral Sigsbee telling of the time when Professor Agassiz was on board the *Blake*.

The gold medal for eminence in the application of science to the public welfare was awarded to Dr. C. W. Stiles. Dr. Welch sketched the life of Dr. Stiles and described his achievements in the field of medical zool-

ogy. His greatest achievement was in recognizing the importance of the hookworm disease and in carrying out with the aid of the Rockefeller fund wholesale measures for its suppression. Dr. Stiles discovered the American variety of hookworm and made a complete survey of the south. At a result of this work the most severe cases of the disease have been eliminated from this country.

Dr. Stiles in receiving the medal told of the contempt that in his early days was cast upon those who attempted to make utilitarian applications of a science like zoology. But in spite of this attitude of hostility toward applied zoology he decided in 1891 to enter the field. Since then zoology has been of service to public health in many ways and there are great opportunities for the future. For instance typhoid fever is now so well understood that it could be completely eradicated by sufficient effort. Dr. Stiles stated he received the medal not so much as an individual but rather as a representative of the Public Health Service.

Dr. Albert Einstein of Berlin was called upon at the close of the session and replied very briefly in German, saying that he would not then speak, but would try to learn English before his next visit to Washington.

E. E. Slosson

Science Service

THIRD AWARD OF THE DANIEL GIRAUD ELLIOT MEDAL

The third award of the Daniel Giraud Elliot gold medal, namely, for the year 1919, together with the honorarium, was voted to Robert Ridgway in recognition of the eighth volume of "The Birds of Middle and North America," which appeared in the year 1919. The two previous awards of this medal were to Frank M. Chapman for his "Distribution of Bird-Life in Colombia," which appeared in 1917, and to William Beebe for the first volume of his "Monograph of the Pheasants," which appeared in 1918. Thus for the third time an American ornithologist secures this medal, an award which is open to the zoologists and palæontologists of the world.

In his address as chairman of the Elliot Medal Committee Professor Osborn spoke as follows:

In undertaking this great work Ridgway was not only placing the crown on his labors of a third of a century, but was giving expression to a plan made by Baird a half century before. Ridgway was therefore doubly inspired when, in 1901, he undertook the stupendous task of preparing a ten-volume treatise on all the birds of the western hemisphere north of South America. With unremitting zeal, and always maintaining the standard of thoroughness and accuracy set by the first volume of the series, he continued his labors until eight volumes have appeared, the last in 1919. Each volume contains about 850 pages, or a total of 6,800 pages in all. Nearly 900 genera are defined and over 3,000 species and subspecies described.

While giving expression to his exceptional powers of analysis and description trained by years of experience and observation, Ridgway has produced a work which in method, comprehensiveness, and accuracy, as well as in volume, has never been surpassed in the annals of ornithology.

It is interesting to add that, like the poet, the ornithologist is born, not made. Remote from museums, libraries, and naturalists, Robert Ridgway was born at Mt. Carmel, Illinois, July 2, 1850. At the age of fourteen we find him trying to identify local birds with the aid of Goldsmith's "Animated Nature" and Goodrich's "Natural History." His first touch with Washington as the great center of ornithological research came through a letter enclosing a colored drawing of the Purple Finch, to which the young ornithologist gave the name "Roseate Grosbeak" (*Loxia rosea*). This letter found its way to the sympathetic hands of Assistant Secretary Spencer F. Baird of the Smithsonian Institution. In Baird Ridgway found a preceptor and friend eminently qualified to guide his special talents. Baird found in Ridgway a pupil who in due time became his worthy successor; and cordial relations then established have continued to bear fruit during the succeeding fifty-seven years.

At the early age of seventeen, that is, in 1867, Ridgway was appointed zoologist of the United States Geological Survey of the 40th Parallel, under Clarence King. Remaining in the employ of the government, he became, in 1880, curator of the Division of Birds in the United States National Museum, a position he still occupies. He was a founder of the American Ornithologists' Union and from 1898 served as its president. A retiring

disposition and close application to his studies have prevented him from taking a prominent part in the activities of natural history organizations, and thereby he has gained time for research which has placed to his credit a greater number of works than has been produced by any other ornithologist. With Baird and Brewer he collaborated in the production of a five-volume quarto on the "Birds of North America." This was followed by his standard "Manual of North American Birds," "Nomenclature of Colors for Naturalists," "Birds of Illinois," and "Color Standards and Color Nomenclature," a work generally accepted by naturalists throughout the world. Meanwhile he had published also some five hundred papers of varying length, and it was not until 1901 that the way was prepared for his *magnum opus*, "The Birds of Middle and North America," the eighth volume of which has won for him the award of the Daniel Giraud Elliot Medal by the National Academy of Sciences.

According to the deed of gift, the award of the Elliot Medal is made "to the author of such paper, essay or other work upon some branch of zoology or palæontology published during the year as in the opinion of the persons, or a majority of the persons, hereinafter appointed to be the judges in that regard, shall be the most meritorious and worthy of honor. . . . As science is not national the medal and diploma and surplus income may be conferred upon naturalists of any country, and as men eminent in their respective lines of scientific research will act as judges, . . . no person acting as such judge shall be deemed on that account ineligible to receive this annual gift, and the medal, diploma and surplus income may in any year be awarded to any one of the judges, if, in the opinion of his associates, he shall, by reason of the excellence of any treatise published by him during the year, be entitled to receive them." Nominations on the work of the year 1920 in zoology and palæontology should be addressed to the Home Secretary of the National Academy of Sciences, Smithsonian Institution, Washington, D. C., by whom they will be forwarded to the committee on award.

Henry Fairfield Osborn
American Museum of Natural History,
New York City, May 4, 1921

SCIENTIFIC EVENTS

THE UNITED STATES PATENT OFFICE

The United Engineering Societies have issued a statement in regard to the situation in the United States Patent Office, calling attention to the fact that wholesale resignations are crippling the service to the point of disorganization and are creating conditions that threaten American industrial enterprise and invention. The council, through its Patents Committee, of which Edwin J. Prindle, of New York City, is chairman, reports that the situation has become almost intolerable and quotes the new commissioner of patents, Thomas E. Robertson, as saying that remedial legislation at the present session of Congress is necessary if results approaching disruption are to be prevented.

The council appeals for support of pending patent legislation, which provides sufficient increases in salaries to check the exodus of employees from the Patent Office to private employment. In a little over one year, 110 members of the force of examiners, numbering 437, have resigned. During the first three weeks of the Harding administration six highly trained experts left the service to accept salaries two or three times as great elsewhere. In the past year 142 of the 560 clerical workers have resigned. There are thirty clerks in the Patent office who receive only $60 a month who would get $1,100 a year under the new salary bill.

Commissioner Robertson is quoted as stating that the Patent Office runs one of the largest ten-cent stores in the world. The enterprise has as its stock about 75,000,000 copies of about 1,500,000 patents, and new patents at the rate of from 600 to 1,000 a week add 50,000 more copies to be taken care of each week. Many patent copies are sold for a dime apiece during the year. There is a stenographic department handling legal work that turned out 13,000,000 words in the past year and brought in $62,000 revenue.

It is the opinion of the engineering, research and manufacturing associations of the United States that the scientific and industrial interests of the country are being jeopardized by

Patent Office conditions. The National Research Council, the American Chemical Society and the National Association of Manufacturers are among the organizations advocating Patent Office relief.

THE NATIONAL GEOGRAPHIC SOCIETY

Because of their important service "for the increase and diffusion of geographic knowledge" the following members of the National Geographic Society have been awarded life memberships, under the provisions of the Jane M. Smith Fund:

R. G. McConnell, of Ottawa, Canada, for his distinguished service to geography in Canadian exploration.

Frank M. Chapman, of New York City, for his researches in ornithology with special reference to the geographic distribution of animal life.

Herbert E. Gregory, of New Haven, Connecticut, for his important original contributions to geographic science.

Donald B. MacMillan, of Freeport, Maine, for his additions to geographic knowledge through Arctic exploration.

J. B. Tyrrell, of Toronto, Canada, for his journeys and reports of exploration and discovery in the wilderness of northwestern Canada.

The National Geographic Society will begin explorations and studies this summer of the Pueblo Bonito and Pueblo del Arroyo ruins in the Chaco Canyon of Northwestern New Mexico. It was decided to study these ruins following a report to Dr. Gilbert Grosvenor, president of the society, and its research committee, headed by Frederick V. Coville, by a reconoissance party which visited the Canyon last summer (1920). The expedition will be led by Neil M. Judd, who has been a member of many expeditions to the American Southwest. The populous habitation of the Canyon in pre-Columbian times presents numerous geographical problems involving the relation of a specialized environment to a people whose traces indicate numerous special characteristics. Not only will the architecture and ceramic remains be studied, but experts in desert flora and geology will accompany the expedition. It is yet to be determined whether the climate conditions have changed or whether the canyon agriculturists had an irrigation system for their crops of beans, corn and squash.

EXCHANGE OF PROFESSORS OF ENGINEERING BETWEEN AMERICAN AND FRENCH UNIVERSITIES

There has been for some time a regular annual exchange of professors between individual universities in France and America in regular academic fields, such as literature, history, law, fine arts, economics, etc., but no such exchange in engineering or applied science. These subjects are taught in France under special faculties, not included in existing exchanges with America. Furthermore, the French methods of teaching these subjects are unlike our American methods, for various reasons, based on the history, traditions and sociology of the two countries. The war showed the importance of engineering in production and distribution, and the many ties of friendship which bind us to France depend in various ways, upon applied science. It should therefore, be to the mutual advantage of France and America to become better acquainted with each other's ideals and viewpoints, in the study and in the teaching of these subjects.

With these purposes in mind, the late Dr. R. C. Maclaurin, in 1919, as president of the Massachusetts Institute of Technology, consulted the presidents of six universities on or near the Atlantic seaboard, as to whether they deemed it desirable to cooperate in a joint exchange of professors with France, on a plan definitely outlined. Their replies being favorable to the project, a committee was appointed, with one member from each of the seven institutions, to report on the plan, and on methods of carrying it into effect. The committee met in December, 1919, and ratified the cooperative plan with some few modifications. The present president of the committee is Director Russell H. Chittenden, of Yale University, and its secretary Dean J. B. Whitehead of the Johns Hopkins University.

Since the Institute of International Education, in New York, concerns itself with the interchange of college students and teachers

from all parts of the world, the committee requested the director, Dr. Stephen P. Duggan, to undertake the negotiations between the committee and the French university administration. The French administration responded cordially to the offer for the annual exchange of a professor. The French have selected, for their first representative, Professor J. Cavalier, rector of the University of Toulouse, a well-known authority on metallurgical chemistry, to come to America this fall, and to divide his time during the ensuing academic year, among the seven cooperating institutions, namely, Columbia, Cornell, Harvard, Johns Hopkins, the Massachusetts Institute of Technology, Pennsylvania and Yale.

The American universities have selected as their outgoing representative for the same first year (1921–22), Dr. A. E. Kennelly, professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology.

GRANTS FROM THE BACHE FUND

Grants from the Bache Fund of the National Academy of Sciences have been made as follows:

$500 to C. H. Warren, Massachusetts Institute of Technology, to defray the expense of chemical analysis in the study of igneous rocks from Massachusetts.

$500 to Waldemar Lindgren, Massachusetts Institute of Technology, for chemical analyses of samples used in a study of additions and losses that limestones from Bingham, Utah, have suffered in contact metamorphism.

$500 to T. H. Goodspeed, University of California, for photographic records and illustration, over a period of three years, for a study of *Nicotiana* in respect of Mendelian inheritance, of quantitative inheritance, of inheritance of inter-specific hybrids, and of the nature of bud variation.

$1,000 to Frank P. Underhill and Lafayette B. Mendel, Yale University, for investigations on deficiencies in nutrition.

$500 to Gilbert N. Lewis, University of California, for the computation of chemical constants.

$300 to H. W. Norris, Grinnell College, Iowa, for the investigation of the nervous system of the Elasmobranch fishes, and for the study of the Ganoid fishes.

$750 to Preston Edwards, Johns Hopkins University, for investigations in acoustics.

SCIENTIFIC NOTES AND NEWS

Mme. Curie, accompanied by her two daughters, arrived in New York City on May 11. Last week she visited Smith, Mt. Holyoke and Vassar Colleges. According to the program that has been arranged, she is given this week a luncheon by the chemists of New York City, a welcome by the American Association of University Women, and a reception at the American Museum of Natural History. On Friday President Harding presents her with a gram of radium on behalf of the women of America.

Dean Albert R. Mann, of the New York State Agricultural College at Cornell University, has been appointed head of the New York State Agricultural Department by the reorganized Council of Farms and Markets. There were three candidates—Raymond R. Pearson and George E. Hogue, who have each held the office, and Dean Mann.

Dr. R. W. Thatcher, dean of the department of agriculture and director of the agricultural experiment station of the University of Minnesota for the past four years, has resigned in order to accept the appointment as director of the New York State Agricultural Experiment Station at Geneva, N. Y., effective on July 1. Dr. W. H. Jordan, who completes twenty-five years of service as director of the station at Geneva on June 30, retires on that date.

Dr. W. J. Mayo and Dr. C. H. Mayo have recently received notification that honorary fellowships in the Royal College of Surgeons of Ireland will be conferred upon them as soon as they can attend the ceremony which will be held in the College Hall.

Dr. Theodore Hough, dean of the medical

department of the University of Virginia, has been elected president of the Association of American Medical Colleges.

Dr. Harry P. Brown, of the New York State College of Forestry, has declined the position of wood technologist at the Imperial Forest Research Institute, Dehra Dun, United Provinces, India, offered to him by the Secretary of State for India.

Sir Wilmot Herringham, chairman of the Committee on Medical Education of the University Grants Committee, and Sir Walter Morley Fletcher, secretary of the Medical Research Council of London, guests of the Rockefeller Foundation, visited the Mayo Foundation and the Mayo Clinic on April 26 and 27.

Arnold William Reinold, F.R.S., for thirty-five years professor of physics at the Royal Naval College, Greenwich, died on June 19, aged seventy-eight years.

Dr. James Law, director emeritus of the New York State Veterinary College, Cornell University, died in Springfield, Mass., on May 11, aged eighty-three years.

Dr. Michael Idvorsky Pupin, professor of electro-mechanics at Columbia University, addressed the meeting of the Columbia Chapter of Sigma Xi on May 4. He spoke on "Progress in physics in the last decade." This was the first of a series of annual lectures on "The Progress of Science."

Dr. T. Wingate Todd, Payne professor of anatomy in the Medical School of Western Reserve University, will deliver in June five special lectures at the University of Ghent, Belgium, on "The growth and metamorphosis of the skeleton." The lectures are supported by the Hoover Foundation provided by the funds remaining after the Commission for the Relief of Belgium had finished its activities.

Professor Albert Einstein, who delivered a series of five lectures on the theory of relativity at Princeton University during the week beginning on May 9, has arranged with the Princeton University Press for their publication in book form. This will be the only authorized publication of the lectures he will give during his present visit to the United States.

The last issue of the *Journal* of the Elisha Mitchell Scientific Society carries an appreciation of the work of Dr. J. J. Wolfe (Harvard), late professor of biology of Trinity College, Durham, N. C. The Biological Club of this institution is raising funds and collecting books for a memorial library.

UNIVERSITY AND EDUCATIONAL NEWS

The West Virginia legislature has appropriated for the University of West Virginia $400,000 for a chemistry building; $300,000 for a gymnasium and $100,000 to complete the law building.

The will of Mrs. William L. McLean, wife of the publisher of the Philadelphia *Evening Bulletin,* leaves $100,000 to Princeton University in memory of her son Warden McLean, of the class of 1912, who was killed in the war.

The inauguration of Dr. Ernest Fox Nichols as president of the Massachusetts Institute of Technology will take place on June 8. Addresses will be made by Governor Cox, Dr. Elihu Thomson, President A. Lawrence Lowell and Professor H. P. Talbot, followed by the inaugural address of Dr. Nichols.

Dr. John Howland, professor of pediatrics at the Johns Hopkins Medical School, director of the Harriet Lane Home and pediatrician in chief of the Johns Hopkins Hospital, has been offered the professorship of children's diseases in the Medical School of Harvard University.

DISCUSSION AND CORRESPONDENCE

EFFECT OF DORMANT LIME SULFUR UPON THE CONTROL OF APPLE BLOTCH

During the progress of investigations on apple blotch (*Phyllosticta solitaria* E. & E.) new and noteworthy facts concerning this important disease are gradually coming to light.

Of particular concern, from the practical viewpoint, is the effect of dormant lime sulfur and copper sulphate sprays upon the pycnospores lodged in the pycnidia and destined to function after petal-fall.

Wallace[1] in his official reports and Douglas[2] have repeatedly published the statement that a very strong solution of lime sulfur, applied before the buds begin to swell, perfectly controlled this disease and that the summer sprays, consequently, were unnecessary. The writer disagrees with their views, but has discovered from field and laboratory experiments and obervations, the scientific explanation of partial control by the dormant sprays applied late.

The infectious surface of an apple blotch canker in the first season of its functional activity consists of two distinct portions: first, that portion which develops from a single infection, becoming apparent in late summer and ceasing its active growth upon the appearance of cold weather; second, that porton which advances from the initial canker the following spring, approximately two weeks after the buds burst open, and which becomes dotted with pycnidia, with mature pycnospores, simultaneously with the advance of the canker. The first portion is the initial canker and bears pseudo-pycnidia. The contents of the pseudo-pycnidia are completely or partially differentiated into spores by the time it is customary to apply the dormant spray. Furthermore, the epidermal covering over the pycnidia is ruptured, exposing the pycnidial wall. The season's young fruits and new growth are, therefore, subject to two distinct sources of infection from the young blotch cankers.

A dormant spray of lime sulfur applied as the buds begin to swell actually kills the spores and sporidal layer within the differentiated pseudo-pycnidia but has absolutely no effect upon the mycelium of the organism ramifying throughout the cortical tissue beneath. The toxic effect upon the spores is very striking after the first rain following the dormant spray. Dilutions of lime sulfur of 1–3, 1–5, 1–6, and 1–8, were given their trial and all were similarly toxic to the spores in the pycnidia, but it appeared that dilutions somewhat stronger than 1–8 were more efficient. A dilution of copper sulphate (1–6) produces similar toxic effects. Scalecide produces none at all.

As was mentioned above, a new infectious area advances from the initial canker in the spring. It follows, therefore, that the dormant spray exercises but very little control upon the season's infection of the young apples and new growth.

E. F. Guba

University of Illinois

[1] Wallace, F. N., 9th Annual Report Indiana State Entomologist, 1915–16, pp. 51, 54.

[2] Douglas, B. W., "War and the Fruit Grower," *Country Gentleman*, September 14, 1918; "Fruit Diseases of 1919," *Country Gentleman*, April 17, 1920.

CROWS AND STARLINGS

To the Editor of Science: Last fall at Devon, Pennsylvania, a man shooting blackbirds also wounded a starling, which fell on the grass and which he could not find. Shortly afterwards several crows were seen diving at something in the grass and then lighting and running through the grass after it. Upon his going towards them to see what they were doing, they all flew away, one of them carrying the starling in its bill, and landed on the walk in a neighboring place, where the crows gathered round the starling and proceeded to peck at it. He followed them and scared them, and the crows flew away, abandoning the starling, which was nearly dead.

I have never before known of crows carrying off as large a bird as a starling, though I have seen one carrying off from the nest a young robin nearly ready to fly, and of course they kill many young robins and other young birds of smaller size.

F. R. Welsh

THE SYNCHRONAL FLASHING OF FIREFLIES

During a trip in Siam, a distinct flashing of fireflies in unison was observed. The observa-

tions were made during the evenings of June 5 and 6, 1920, from a house boat on the Tachin River, in the district of Sarm Prarm, Nakorn Chaisri, Siam. A distinct flashing of dark and light was observed. A whole tree of flies would flash all together at regular intervals of, by count with a watch, between 105 and 109 flashes a minute.

Frequently entire trees filled with fireflies are observed at the College of Agriculture, Los Baños, Laguna, Philippine Islands and it was at first thought by the writer that an extremely rapid flashing in unison took place. After, however, observing the distinct flashing in unison of the fireflies in Siam it can be stated with certainty that no such synchronal flashing took place at Los Baños.

Determinations made by H. E. Woodworth, of the College of Agriculture, Los Baños, on fireflies from Siam, showed these flies to be of the genus *Calaphotia*. Professor Woodworth states that the firefly at Los Baños is of the same genus, but of a different species. Neither species has been determined.

OTTO A. REINKING

COLLEGE OF AGRICULTURE,
LOS BAÑOS, PHILIPPINE ISLANDS

FRANZ STEINDACHNER

TO THE EDITOR OF SCIENCE: I read with much interest the article of Dr. Jordan on Franz Steindachner. I had the great pleasure of visiting Dr. Steindachner twice; once in 1878 and again twenty years later in 1898. He was living in the simple way described by Dr. Jordan on the occasion of both my visits. His maiden sister at that time, however, was living and was keeping house for him in a perfectly simple manner.

I do not wish to speak of Steindachner's great achievements in ichthyology. I want to add my little tribute to his value as a friend. The simplicity of his life, the wonderful clarity of his character and his devotion to his friends make him almost as renenowned as his achievements in the investigation of fishes. At the time of my last visit he had achieved the full distinction of head superintendent of the Royal Imperial Museums. He enjoyed to a remarkable degree the confidence of the Emperor Franz Josef. Through a special permit from the imperial palace I was permitted under his guidance to visit the castle with all of its belongings in which the heir to the throne was murdered a few years before.

I was particularly struck with the amity and friendship shown him by the people with whom he worked. As a host he was the essence of geniality and at the same time of simplicity. I carried letters to him on my first visit from friends in Harvard who knew him when he was a resident of Cambridge. He had a great admiration for this country and he numbered many personal and professional friends on this side of the water. While war broke up all political and many social relations with Germany and Austria, I feel quite certain all the personal friends of Dr. Steindachner on this side remained loyal to him through his later years of sorrow and distress, due to the exigencies of the war. The grief for him as a friend is more poignant than the regret of his loss to science.

H. W. WILEY.

SCIENTIFIC BOOKS

Chemische Krystallographie. By P. GROTH. Leipzig, Wilhelm Engelmann. Vol. I., 1906; II., 1908; III., 1911; IV., 1917; V., 1919. 4,443 pages, with 3,342 figures; 8vo, cloth.

All persons interested in crystallized substances will be delighted to know that this monumental work, in the preparation of which Professor Groth spent several decades, has been finally completed. Notices of the publication of the first three volumes have already appeared in SCIENCE.[1] Vol. IV. was issued in 1917 and Vol. V. late in 1919.

According to the original plan it was thought that all the available material could be conveniently published in four volumes; the first two to be devoted to inorganic, and the last two volumes to organic compounds. The aromatic organic compounds, however, proved to be much more numerous than had been

[1] Vol. XXV., 143–144; Vol. XXVIII., 843; Vol. XXXIII., 253.

anticipated, so that two large volumes have been necessary to describe them. These two volumes contain 1,846 pages and 1,783 figures. In these volumes the treatment used in the others has been followed.

Chemists and crystallographers, the world over, are greatly indebted to Professor Groth for this most important reference work, which is a critical survey of all the crystallized material described thus far. As is generally known, Professor Groth has devoted his life to problems in chemical crystallography. He was the founder of and for many years the editor of the *Zeitschrift fuer Krystallographie und Mineralogie*. Hence, he was peculiarly fitted to undertake this very difficult and time-consuming task.

Edward H. Kraus

Mineralogical Laboratory,
University of Michigan

SPECIAL ARTICLES

THE CHANGE IN THE FAT OF PEANUT-FED RABBITS

In the course of our investigation of the soft pork of peanut-fed hogs it occurred to me that if an animal in starving used its liquid fat first, this would make it possible to overcome the softness of the pork on peanut-fed hogs. If the animal used the liquid fat first in starving it would be reasonable to suppose that if both liquid and solid fat were fed at the same time he would use a greater proportion of the liquid fat to meet the energy requirements of his body. Then it would be possible to attack the soft pork problem in two ways. One would be to feed peanuts alone for forty or fifty days then starve the hog for some eight or ten days so as to remove the liquid fat as much as possible, and afterwards finish the feeding with other feeds. The other way would be to feed the peanuts not alone for forty or fifty days as is the custom but to feed them with some feed that would produce solid fat and in this way the animal would use a greater percentage of the soft fat that was fed than he would otherwise. We got some results this past spring which indicated that it is much better to feed the hogs peanuts with other feeds for seventy days than it is to feed for forty or fifty days with peanuts alone, then to finish with other feeds.

To determine whether an animal in starving uses the liquid fat more rapidly than it does the solid fat, rabbits were fed on peanuts and alfalfa for six weeks. One of the rabbits was killed at the end of the feeding period and the others were killed after starving three, five and seven days. The iodine numbers of the kidney fat and the back fat were determined. Two series of rabbits were treated in this way but the results of the last series only will be given.

Rabbit No.	Iodine Number of Back Fat	Iodine Number of Kidney Fat
1	96.23	98.00
2	78.34	97.92
3	70.98	95.33
4	66.22	92.36

The per cent. of the livers extracted by ether, were rabbit 1, 8.15, rabbit 2, 17.04 rabbit 3, 19.18, rabbit 4, 20.09. It was expected that the ether extract of the livers would increase in starvation and it was thought that the iodine number of this extract would increase but in this last we were disappointed as the iodine number was practically constant, showing the values from 98 to 104.

Our results indicate that the liquid fat of an animal during starvation is used more rapidly than the solid fat, that the liquid fat of the back or subcutaneous fat is used more rapidly than that of the kidney. It is our intention to repeat this work, beginning in about a month, using pigs instead of rabbits.

S. T. Dowell

Oklahoma Agricultural
Experiment Station,
Stillwater

THE AMERICAN SOCIETY OF MAMMALOGISTS

The third annual meeting of the American Society of Mammalogists was held in the United States National Museum, Washington, D. C., May 2–4, 1921. Officers elected for the

year are Dr. E. W. Nelson, *president;* Dr. Wilfred H. Osgood and Mr. Gerrit S. Miller, Jr., *vice-presidents;* Dr. H. H. Lane, *recording secretary;* Dr. Hartley H. T. Jackson, *corresponding secretary;* Mr. Arthur J. Poole, *treasurer.* Mr. N. Hollister was reappointed *editor,* and *director ex officio.* The following were elected *directors of the 1921 class:* Dr. Glover M. Allen, Dr. J. Grinnell, Dr. Witmer Stone, Dr. J. C. Merriam, Mr. H. E. Anthony. Upon recommendation by the directors, ninety-nine new members were elected. The Society voted to affiliate with the American Association for Advancement of Science. It also authorized the appointment of a Committee on Marine Mammals to cooperate with the National Research Council or other agencies toward the international preservation of marine mammals.

The following was the program:

MONDAY, MAY 2, 10:00 A.M.

Meeting of the Board of Directors

Afternoon Session, 2:00 P.M.

Remarks on certain mammals of Panama: E. A. Goldman.

A singing mouse: H. H. Lane.

Disposition and intelligence of the orang-utan: W. H. Sheak.

The California elk-drive of 1904: C. Hart Merriam.

Some observations on beaver culture with reference to the national forests: Smith Riley.

Progress in mammalogy during 1920. General discussion for members, led by T. S. Palmer.

Evening Session, 8:15 P.M.

A motion picture record of the animal collections of the Washington and Philadelphia Zoological Parks. (Made with the camera invented by Carl E. Akeley.) Arthur H. Fisher.

TUESDAY, MAY 3

Morning Session, 10:00 A.M.

Geography and evolution as pertaining to the kangaroo rats of California: Joseph Grinnell.

Nerve-endings of the maculæ and cristæ acusticæ: H. H. Lane.

Business Session, 10:45 A.M.

Afternoon Session, 2:00 P.M.

Life histories of African squirrels and related groups: H. Lang.

(*a*) *Meaning of California records for the buffalo:* (*b*) *The range of mountain sheep in northern California:* C. Hart Merriam.

Habits of the mammals of Celebes and Borneo: H. C. Raven.

WEDNESDAY, MAY 4

Morning Session, 10:00 A.M.

Present status of some of the larger mammals of Canada: R. M. Anderson.

Observations on certain specialized structures of the integument of primates. (*a*) *Carpal sinus hairs.* (*b*) *A sternal gland in the orang-utan:* Adolph H. Schultz.

Improved methods of trapping small mammals alive: Vernon Bailey. (Presented by E. A. Goldman.)

Life-zones of southern Ecuador: H. E. Anthony.

Remarks on the distribution and relationships of the North American chipmunks: Arthur H. Howell.

Some significant features of economic mammalogy: W. B. Bell.

1:00 P.M.

Administration Building, National Zoological Park

Luncheon for members and their wives, as guests of the Administration of the National Zoological Park and the Washington Members.

2:15 P.M.

Final Business Session

2:30 P.M.

Tour of National Zoological Park under direction of N. Hollister, superintendent.

Hartley H. T. Jackson,
Corresponding Secretary

SCIENCE

NEW SERIES
VOL. LIII, NO. 1378

FRIDAY, MAY 27, 1921

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SCIENCE

FRIDAY, MAY 27, 1921

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

ON ACOUSTIC PRESSURE AND ACOUSTIC DILATATION

1. *Introductory. Apparatus.*—On a number of occasions, heretofore[1] I have endeavored to use the interferometer for the measurement of Mayer and Dvorak's phenomenon: but though the experiments seemed to be well designed and were made with care, they invariably resulted in failures. The present method, however, has been successful and led to a variety of results.

The apparatus is shown in Fig. 1, where B is a mercury manometer described elsewhere, the displacements being read off by the component rays LL' of the vertical interferometer. The mercury of the U-tube is shown at $m\ n\ m'$, above which are the glass plates g, g', the former being hermetically sealed, the latter loose, so that the air has free access. The closed air chamber R above m, receives the air waves from the plate of the telephone T by means of the quill tubes t hermetically sealed into the mouthpiece of the telephone, and t' sealed into the manometer. Finally t'' is a branch tube ending in a small stopcock C or similar device at one end, while the other communicates with tt'. Flexible rubber tube connectors may be used at pleasure, so long as the space bounded by the outer face of the telephone plate, the mercury surface m and the stopcock C is free from leaks.

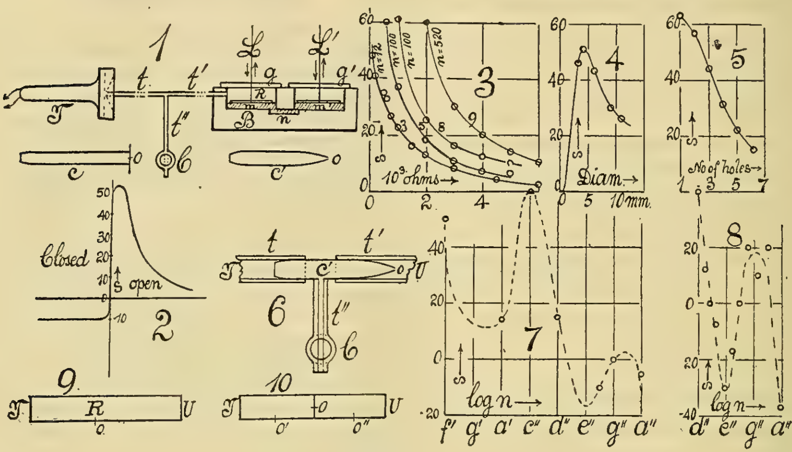
The cock C will eventually be replaced by the glass tubes c and c' (enlarged) perforated with minute orifices at O at one end and open at the other.

The telephone is energized by two storage cells and a small inductor with a mercury or

[1] Carnegie Publ., No. 149, part III., pp. 206–08, Washington, 1914, and subsequently. The phenomenon has been studied by Rayleigh, Kolacek, Lebedew, Wien, Geigel and others. As to hydrodynamic forces in pulsating media, the researches of Bjerknes and W. König should be mentioned.

other break. Large resistances are to be put in the telephone circuit so that the inductances are of secondary importance. The bore of the tubes t, t', c, c' need not exceed 5 mm. Thus the chamber in B, about 6 cm. in diameter and 2 cm. deep, is the resonator (capacity 57 cm.^{3}) of the apparatus.

When the cock C is closed there is no appreciable effect until the telephone resounds harshly. In such a case there is marked dilatation in the resonator R, increasing with the intensity of vibration. The successive readings (s' fringes) are liable to be fluctuating, but the sign and mean value is definite.



Figs. 1 to 8

The displacements of the achromatic fringes corresponding to the head of mercury in B may be read off by a telescope provided with an ocular .1 mm. micrometer. It is perhaps advantageous to place the micrometer in the wide slit of the collimator, the fringes being parallel to the scale parts. To obviate the need of adjusting the inclination of the fringes (as this frequently changes), the slit holder should be revolvable around the axis of the collimator, the scale being parallel to the length of the slit and the fringes moving in the same direction across the white ribbon-like field. Fringes equal to a scale part in breadth are most convenient.

2. *Observations. Closed and Open Resonators.*—Spring interruptors dipping in mercury were first used, having frequencies of $n=12$ and 100 per second, respectively.

Since for $s'-s_0=s$ the head is $s\lambda/2$ (the displacement being s fringes of wave-length λ), this mean value, $s=7$ fringes for the given intensity of vibration, is at once equivalent to $\Delta p=2\times10^{-4}$ cm. of mercury, or to about 3×10^{-6} atmosphere. If but 500 ohms are put into the telephone circuit, however, appreciable deflection ceases.

Again, if the stopcock C is completely open no effect whatever is obtained. The bore of the small stopcock in this case need not exceed 2 or 3 mm. All the negative results which I obtained by other methods heretofore are thus explained.

3. *Resonator All but Closed.*—If now the plug of the cock C is rotated from the open position gradually until the opening is reduced to the merest crevice, the fringe deflection s will, on further slow rotation, be

found to increase from zero, with great rapidity to a positive maximum. The deflection then falls off with similar rapidity through zero to the negative value when the cock is again quite closed. I have indicated this result graphically in Fig. 2, in which the abscissas show the degree to which the cock has been opened and the ordinates the fringe deflections, s, obtained. The maximum pressure obtained in these initial experiments was the equivalent of about 50 fringes; *i.e.*, $\Delta p = 1.5 \times 10^{-3}$ cm. or about 2×10^{-5} atmosphere for a frequency of about 12 per second. At higher frequencies this datum is much increased.

These pressures are real: for on suddenly closing the cock at the maximum and breaking the current, they are retained until discharged on opening the cock.

4. *Pressure Depending on the Frequency and on the Intensity of Vibration.*—The maxima are observable for very considerable reductions of the intensity of vibration. In Fig. 3 curves 3, 5, I have given examples of the observed fringe displacement, s, when different resistances (given by the abscissas in 10^3 ohms) are put in the telephone circuit. In curve 3 the frequency is $n = 12$ per second. Curve 5 contains similar results when the frequency is $n = 100$ per second. The sensitiveness has obviously greatly increased and in a general way this is the case for higher frequencies.

5. *Fringe Deflection Varies as Current Intensity.*—The graphs, Fig. 3, are roughly hyperbolic, so that the equation $rs = C$ (r being the high resistance inserted into the telephone circuit) may be taken to apply within the errors of observation for resistance exceeding 1,000 ohms. So computed for convenience rs is 24×10^3 in series 3 and 36×10^3 in series 5. Hence at $r = 100$ ohms the pressure would have been 7×10^{-3} and 1.1×10^{-2} cm. of mercury. The instrument taken as a dynamometer is thus noteworthy, since its deflections would vary as the first power of the effective current or $i = i_0 s$. It is of interest, therefore, to ascertain how far the sensitiveness which can not here be estimated as above 10^{-4} amperes per fringe, may be increased.

6. *Pin Hole Sound Leaks.*—Pin holes less than a mm. in diameter seem more like a provision for light waves, than for sound waves often several feet long; but one may recall the phenomenon of sensitive flames.

It is so difficult to make the fine adjustment for maximum conditions with stopcocks that their replacement by the devices given in c and c', Fig. 1, is far preferable. Here c is a quill tube, to one end of which a small sheet of very thin copper foil has been fastened with cement. The sound leak at O is then punctured with the finest cambric needle. The other end (somewhat reduced) is thrust into a connector of rubber tubing *at* t''. In case of c' the tube has been drawn out to a very fine point. This is then broken or ground off until the critical diameter (.04 cm.) is reached. Both methods worked about equally well but in the case c several holes side by side or holes of different sizes may be tried out. Such results are shown in Fig 4, which exhibits the deflection (s fringes, ordinates) for different diameters of hole in mm. (abscissas), when 1,000 ohms were put in the telephone circuit. It will be seen that the optimum .4 mm. in diameter is quite sharp. The finest size of needle is needed.

An example of results obtained with the sound leak c when different resistances are in circuit, is given in Fig. 3, curve 8. The value of rs; viz.,

s	51	25	16	12	10	5	fringes
$10^{-3}r$	1	2	3	4	5	10	ohms
$10^{-3}rs$	51	50	48	48	50	50	

is much more constant than hitherto and reaches 50×10^{-3}. Hence at 100 ohms the pressure increment should be $\Delta p = 1.5 \times 10^{-2}$ cm. of mercury.

Figure 5 finally indicates that the multiplication of pinholes, all of the same diameter (.04 cm.) is similarly disadvantageous. The deflection for four holes is scarcely half as large as for one.

If with the current on, a drop of water is placed on the hole O in c, Fig. 1, the pressure

is long retained whether the current is thereafter broken or not. It is gradually dissipated, however, as the joint at the telephone plate is rarely quite tight; and when the telephone sounds, pressure increments may even become negative, as above. If most of the water is removed by bibulous paper a moderate fairly constant pressure is usually observed for some time, until (doubtless with the breaking of the film across the hole) the maximum is suddenly again attained.

7. *Inside and Outside Stimulation.*—When the tube c' is inserted within the rubber connectors t, t' in the absence of vents, there is much undesirable pressure disturbance at the outset, which is but very slowly dissipated. Moreover the closed space can not be opened again at pleasure without similar commotion. I, therefore, used the apparatus, Fig. 6, in preference, in which the pinhole tube c' is provided with a branch tube t'' and cock C. The rubber tube t leads to the telephone (beyond T) and the tube t' to the mercury U-tube (beyond U). If C is open, c' may be inserted or withdrawn with facility. If C is closed the resonator R is closed, as in the above case.

Using the mercury interruptor (frequency c) with 2,000 ohms in circuit the deflection of the closed region was invariably negative. The deflection is peculiar, moreover, inasmuch as it is a slow growth within a minute or more, to a maximum. On breaking the current the deflection dies off in the same slow fluctuating way. If the cock C is opened, the zero is instantaneously recovered. In other words the dilation is due to a loss of gas within the closed region, which loss is but slowly restored after the telephone ceases to vibrate.

If the cock C, Fig. 2, is opened at the critical point, or if it is replaced by the tube c, the deflection is again positive. The action of c thus exceeds that of c', probably because the pinhole in c happens to be nearer the critical size than in c'.

The question next at issue is the influence of pitch upon the dilatation of the closed resonator R. An electric siren (§ 8) was here used with 2,000 ohms in the telephone circuit. The results appeared about as follows:

g' to b'	c''	d'' to e''	f''	g''	pitch
— 5	— 25	maximum estimated at — 200	— 35	0	fringes

There is thus an enormous maximum dilatation somewhere in the range of frequency d'', e'', which from the hovering character of the deflection is not further determinable. This amounts to a pressure decrement of $\Delta p = -6 \times 10^{-3}$ cm. of mercury with 2,000 ohms in the telephone circuit. At 100 ohms it would have been about a millimeter of mercury.

The slow growth of relatively enormous pressure decrements here recorded is so surprising that further experiments are needed. To begin with one may ask whether the telephone plate, held as usual by strong screw pressure between annular plates of hard rubber, is adequately airtight. I therefore removed the telephone and sealed all these parts with cement, thoroughly.

On replacing the telephone with the adjustment as in Fig. 6, the behavior had in fact changed, the negative pressure being of the small value indicated in §2, without growth in the lapse of time. In other words the presence of the pinhole c' within the closed region was now ineffective.

We may summarize these early results for the particular frequencies used, as in Figs. 9 and 10. In an air region R, closed on one side by a vibrating telephone plate T and on the other by a quiet plate U, the pressures are distributed as if there is a maximum at T and a minimum at U. If the region R, Fig. 9, communicates with the atmosphere by a pinhole O of the critical diameter, the pressure within R is raised as a whole by the amount which the pinhole air valve will withstand. Again if the closed region T U, Fig. 10, contains a pinhole valve O within only, it does not differ essentially from the corresponding case in Fig. 9; but if an additional very fine leak O' is supplied on the T side, Fig. 10, the U side gradually develops a large pressure decre-

ment; whereas if the pinhole is supplied on the U side, this develops the usual pressure increment. In the former case air leaks out of O' diffusively; in the latter it leaks into O''.

After many trials, however, only in one case did I succeed in obtaining pressure decrements with pinholes, screw cocks, etc.; this when lost could not be recaptured; but all the present and following results in acoustic dilatation were strikingly reproduced by putting a new telephone with unsealed plate in circuit.

With the apparatus, Fig. 1, and the cock C opened at the critical point, a diapason c'' blown in the vicinity of the cock was easily identified and the octave c''' even three times as active (15 fringes). In another adjustment, the shrill overtone gave nearly 100 fringes. There is some misgiving in interpreting these data, as the open mouth of the pipe must usually be closed to the mouth of the cock; but as the overtone was still appreciably effective six inches to a foot away, the results are probably trustworthy.

8. *Effect of Resonance.*—While a parallel relation of the maximum pressure to the frequency of the telephone note has been shown to exist, it is obvious that the best conditions for high maxima will occur under conditions of resonance between the natural R and the T vibrations (Fig. 1) or their harmonics. I, therefore, used the same small induction coil with two storage cells, but with a commutator-like current-breaker, controlled by a small electric motor with a variable resistance in circuit (electric siren). By gradually decreasing this resistance all chromatic intervals between about f' and a'' were obtainable. The speed of the motor, however, fluctuated slightly, while intervals within a semitone often produced large pressure differences. Thus the determinations of the intervals of a somewhat flickering pitch in all chromatics is quite difficult, even for a musical ear. A series of organ pipes within the given range seemed to offer the best standards of comparison, as it was necessary to turn rapidly from one series of observations to another.

In this way the graphs given in Figs. 7, 8, were worked out, the curves showing the fringe displacement s to the logarithmic frequency n of the telephone. In Fig. 7, to limit the deflections within the range of the ocular, about 2,000 ohms were put in circuit. Three maxima and three minima (one positive and two negative) are indicated. The maximum below f' could not be reached. The strong one at c'' was well marked and approachable from both sides. The small one near g'', though easily observed by continuously changing the pitch, was difficult to record.

The latter, however, is particularly interesting as it introduces the strong pressure decrements at a''. I, therefore, reexamined it in Fig. 8 with less resistance (1,000 ohms) in circuit and the results came out more clearly. The deep minimum at a'' deserves further investigation, as it precedes a probably very high maximum at the near c'''. At least this may be inferred from the stimulation produced by an organ pipe used on the outside of the apparatus, §7. Something better than the electrical siren used will have to be devised; but apart from this the results are very definite.

Adjusting the siren for the maximum c'', the sensitiveness with different resistances in circuit (2,000–9,000 ohms) was determined. The curve is shown in series 9, Fig. 3, and is the highest thus far obtained. The equation, $rs =$ constant, does not fit so well here, a result inseparable from the slightly fluctuating note; for this makes a big difference in the maximum. The mean value is about $rs = 80 \times 10^3$. Referred to a circuit resistance of 100 ohms this is equivalent to a deflection of 800 fringes and a pressure of $\Delta p = .024$ cm. of mercury.

An auxiliary telephone placed in circuit with that of T, Fig. 1, affords no suggestion of these occurrences. Its notes rather increase in strength regularly with the pitch. Yet if the note should happen to be near e'', the other telephone would show no deflection.

Finally the use of the pin hole vent as a *probe* to detect the distribution of compression

in organ pipes has been very fruitful; but these results will have to be omitted here.

9. *Reversal of Poles of Telephone Changes Sign of Fringe Deflection.*—An earlier detection of this result would have saved me much mystification. Not expecting it, I did not look for it; but it seems that a reversal of the telephone current (so to speak) reverses the fringe deflection, symmetrically. It is merely necessary to add a switch to the telephone circuit to prove this. Moreover for a given position of the switch and in the proper order of frequency, pressure increments pass continuously into pressure decrements (Fig. 7).

To test the case further, I used the motor interruptor, making a survey for frequencies between g' and a'' with the switch reversed and the sealed telephone. The new curve corresponded very fully to the curve, Fig. 7, except that maxima and minima had been exchanged. Thus the apparatus regarded as a dynamometer would, with a proper selection of frequency, give both quantity and sign of the impulsive currents in the telephone.

Since the resonating region R is vented by the pinhole, the positions of equilibrium of the quiet and of the vibrating plate are ineffective. Hence it is necessary to assume that the vibrations of the plate are here not symmetrical; or that, for instance, the impulse corresponding to the break of current at the interruptor is of excessive importance.

A closed region may be filled with an excess of compressed wavefront successions, provided means are at hand for the supply of the extra air needed and the energy dissipated; conversely, the closed region may be filled with an excess of rarified wavefront successions if the outflow of superfluous air is possible. In both cases the vent must be so small as to leave the region virtually closed. A ray of light imprisoned in a chamber closed with perfect mirrors might be considered as analogously circumstanced.

10. *Removal of Pressure Decrements Associated with Pressure Increments.*—Marked pressure decrements occur near the minima at c'' and a'' in case of the prolonged tests in §8. One may, therefore, suspect that (as in §7), the decrements result from an insufficiently tight joint at the telephone plate. The telephone with sealed plate was, therefore, carried through the chromatic series of notes from f' to a''. It is needless to give the data here, because they resembled Figs. 7 and 8 in character, except (as was anticipated) that there were no pressure decrements at the minima. In fact the maxima (below f' at c'', g'' and above a'') came out more sharply than in Figs. 7, 8 and the now positive minima (near g', d'', a'') equally so. It seems as if the ordinary overtones in the key of C were in question.

Replacing the sealed telephone by the usual apparatus with clamped plate, the results of Figs. 7, 8 with marked dilatations at the minima were reproduced at once, except that the maxima (a', c'', a'') were in the key of A, in accordance with the increased volume.

Finally I tested the above telephone with sealed plate again and found that pressure decrements at the minima associated with pressure increments at the maxima (as in Figs. 7, 8) had reappeared. These relations were exchanged on reversing the current. I suspect, therefore, that the potent influence is the mode of vibration (modified by sealing) of the telephone plate itself. About this I shall have something to say in the near future, showing that each inductive impulse is followed by shock waves in the plate, of relatively very high frequency compared with the frequency of induction, just as an anvil rings after each blow of the hammer.

Carl Barus

Brown University,
Providence, R. I.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

DUTY ON SCIENTIFIC APPARATUS FOR EDUCATIONAL INSTITUTIONS

The following resolution regarding duty-free importation of scientific materials and scientific books in the English language into the United States by educational institutions have been passed by the American Association for the Advancement of Science:

WHEREAS, the scientific education of the youth of the United States is among the most fundamental and important functions of the Republic, education being the only means by which the advantages of present civilization may be surely transmitted to coming generations of citizens and by which the future progress of the Republic may be assured; and

WHEREAS, the prosecution of the said scientific education of the youth requires unrestricted employment of the apparatus and materials of science in educational institutions, this being increasingly true for more advanced education; and

WHEREAS, the scientific materials and apparatus to be used in educational institutions ought to be selected, as far as possible, without consideration of their place of origin, since science is worldwide in its scope; and

WHEREAS, any increase in the cost of scientific equipment for education is to be greatly deplored, since the funds available for its purchase by educational institutions are invariably inadequate in comparison with the great needs and possibilities of education; and

WHEREAS, institutions for higher education must still be relied on for the most fundamental and farreaching steps in the advancement of knowledge, through the scientific researches of their faculties and students; and

WHEREAS, both financial and patriotic considerations clearly require that the Republic should aid fundamental scientific research in every possible way, especially avoiding the erection of artificial barriers across the path of the advance of true knowledge; and, finally,

WHEREAS, in consideration of the foregoing clauses, The American Association for the Advancement of Science, with its 12,000 members, almost all of whom are citizens of the United States—representing the fundamental scientific interests of the country from the standpoint of scientific research as well as from that of instruction, and representing especially the institutions for higher education and their staffs—views with very serious concern the proposal to repeal section 573 of the tariff act of October 3, 1913, which allows the duty-free importation of scientific materials by educational institutions; therefore, be it

Resolved, that The American Association for the Advancement of Science respectfully calls the attention of the Congress of the United States to the very great hindrance and burden that would be imposed upon the scientific education and research in the Republic if its educational institutions were to be deprived of the privilege of duty-free importation of scientific apparatus and materials, which they have enjoyed for many years; and be it further

Resolved, that the American Association also respectfully urges the restoration of the corresponding privilege of duty-free importation of single copies of scientific books in the English language by recognized educational institutions and the faculties, such books constituting an important item of both institutional and personal equipment for advanced instruction and research, especially since it is undesirable that scientific publications in languages other than English should be artificially favored in the United States; and be it finally

Resolved, that these resolutions be forwarded to the proper committees of the Congress of the United States, to the National Academy of Sciences, to the National Research Council, and to the secretaries of the scientific societies affiliated with the American Association, that they be published in SCIENCE, official organ of the association, and also that they be sent to each member of the association.

SCIENTIFIC EVENTS

'SCIENCE' AND THE PRINTERS' STRIKE

THE printers of SCIENCE are making special efforts to bring out the journal in spite of the general strike of compositors affecting the offices in which most of our scientific journals are printed. In order to assist them, the present number is reduced somewhat in size and is using mainly matter in type prior to the strike. The present issue gives first place to an important article which under ordinary circumstances would be printed in the department devoted to special research. It may again be noted that the advertisers have been requested to use copy already in type.

The Council of the American Chemical Society voted at their recent Rochester meeting:

> That this council expresses to the directors of the society the hope that the Eschenbach Printing Company will be released from any forfeits that may arise under the terms of its contract in connection with the impending strike, due to the insistence upon the 44-hour week, and

That the members of this council also express their willingness, in the event such a strike is not amicably settled, to wait indefinitely for the publication of the journals of the society.

THE BRITISH INSTITUTE OF PHYSICS[1]

The Institute of Physics was inaugurated at a largely attended meeting in the hall of the Institution of Civil Engineers on April 27. The need has long been felt for a corporate body, analogous to the Institute of Chemistry, which should strengthen the position of workers engaged in physics, and form a bond between the various societies interested in the subject. The institute has now been founded by the cooperation, in the first instance, of the Faraday Society, the Optical Society and the Physical Society of London, while the Royal Microscopical Society and the Roentgen Society have since decided to participate. In opening the proceedings, the first president, Sir Richard Glazebrook, said that the work of the physicist would become more and more important in the future, both in pure and applied science, and one of the aims of the institute was to accelerate a recognition of the physicist's position and value. Many developments in physics had been of vital importance during the war, but men who had done important work as physicists could only be given an official status in some cases by being termed research chemists. He added that the membership of the institute was already about 300, and comprised most of the leaders in physical science. Sir J. J. Thomson, who, it was stated, was willing to be nominated as president for the next year, gave a brief address. He said that to one who regarded chemistry as a branch of physics it was rather anomalous that hitherto there should have been an Institute of Chemistry and not an Institute of Physics. He had been a student of physics for fifty years. At the beginning of that period physics was like an army with great generals but few troops. There were at that time perhaps a dozen laboratories in the country. Opportunities multiplied rapidly, however, and students with them, and salaries also increased so that physics now offered to every competent man a livelihood though but small hope of a fortune. To-day the demand for competent physicists exceeded the supply. Research was expensive for the student and for the university, and perhaps this fact was not sufficiently recognized, although more money was available for research now than ever before. He saw no disposition to neglect or undervalue pure research, undertaken without any thought of an industrial application, and he congratulated the institute on representing a profession which not only contributed so largely in various ways to human comfort, but aided the intellectual development of mankind. The Right Hon. A. J. Balfour extended a cordial welcome to the Institute. He had been greatly surprised to learn that there was not already in existence an institute of physics. After all, physics was the most fundamental of all the sciences. Whatever a man's line of research might be, if he could find a physical explanation for the phenomena he was examining, then, and then only, could he hope for something like finality in his investigation. It was certainly surprising that in this country, which had not lagged behind any country in the world in the great advances it had made in regard to the physical knowledge of the universe, they had not had an institute of physics before now.

[1] From the *British Medical Journal.*

THE BOSTON MEETING OF THE AMERICAN MEDICAL ASSOCIATION

The seventy-second annual session of the American Medical Association will be held in Boston, Mass., June 6–10, 1921, under the presidency of Dr. William C. Braisted. The scientific assembly of the association will open with the general meeting to be held at 8:30 P.M., Tuesday, June 7. The Sections will meet Wednesday, Thursday, and Friday, June 8, 9 and 10 as follows:

Convening at 9 a.m., the Sections on Practise of Medicine; Obstetrics, Gynecology and Abdominal Surgery; Laryngology, Otology and Rhinology; Pathology and Physiology; Stomatology; Nervous and Mental Diseases; Urology; Preventive Medicine and Public Health.

Convening at 2 p.m., the Sections on Surgery, General and Abdominal; Ophthalmology; Diseases of Children; Pharmacology and Therapeutics; Dermatology and Syphilology; Orthopedic Surgery; Gastro-Enterology and Proctology; Miscellaneous.

Among the foreign guests will be: Dr. W. Blair Bell, Liverpool; Dr. H. E. G. Boyle, London; Dr. Jacques Calve, Plage, France; Sir George Lenthal Cheattle, London; Dr. Walter W. Chipman, Montreal; Dr. Pierre Janet, Paris; Sir Robert Jones, Liverpool; Professor V. Putti, Bologna, Italy; Dr. Richard G. Rows and Lieutenant-Colonel Henry Smith, London; Professor Soubbotitch, Belgrade, Serbia; and Drs. M. Turin and A. Widmer, Territet, Switzerland.

MME. CURIE'S VISIT TO THE UNITED STATES

The events in honor of Mme. Curie arranged for last week were carried out in accordance with the program. On Tuesday, May 17, she was given a luncheon in New York by the American Chemical Society, the American Electrochemical Society, the Chemists Club and American sections of the Société de Chimie industrielle and the Society of Chemical Industry. Dr. Edgar F. Smith presided and addresses of welcome were made by Dr. Robert B. Moore, chief chemist of the Bureau of Mines; Dr. Francis Carter Wood, head of the Crocker Cancer Research Laboratory of Columbia University; and Professor George B. Pegram, dean of the Columbia University School of Mines.

In the evening a reception in honor of Mme. Curie was given at the American Museum of Natural History by the New York Academy of Sciences and the New York Mineralogical Club, at which Dr. Michael I. Pupin, professor of electro-mechanics at Columbia University; Dr. Robert Abbe, Dr. George F. Kunz and Professor Alexander H. Phillips, of Princeton University, made addresses. Mme. Curie's election as an honorary fellow of the American Museum of Natural History was announced by Dr. Henry Fairfield Osborn.

On Wednesday afternoon the American Association of University Women, presided over by Mrs. Edgerton Parsons, welcomed Madame Curie in Carnegie Hall. Dean Ada Comstock, of Smith College, president of the association, extended a welcome on behalf of the college and university women of the United States. Addresses were made by Dr. Florence Sabin, professor of histology at the Johns Hopkins University, and Dr. Alice Hamilton, of the Harvard Medical School. President Pendleton, of Wellesley College, announced the award to Mme. Curie of the special Ellen Richards Research Prize of $2,000.

On Thursday evening, at a dinner given in her honor by the National Institute of Social Science, the gold medal of the society was presented by Dr. Henry Fairfield Osborn, who read the presentation address of Vice-president Coolidge, who was absent on account of illness.

The gram of radium valued at $120,000, a gift from the women of America, was presented to Mme. Curie by President Harding on May 20. M. Jusserand, the French Ambassador, made a brief introduction. After the presentation Mme. Curie responded as follows:

> I can not express to you the emotion which fills my heart in this moment. You, the chief of this great Republic of the United States, honor me as no woman has ever been honored in America before. The destiny of a nation whose women can do what your countrywomen do to-day through you, Mr. President, is sure and safe. It gives me confidence in the destiny of democracy.
>
> I accept this rare gift, Mr. President, with the hope that I may make it serve mankind. I thank your countrywomen in the name of France. I thank them in the name of humanity which we all wish so much to make happier. I love you all, my American friends, very much.

In the evening at a meeting held under the auspices of the U. S. National Museum, presided over by Dr. Charles D. Walcott, of the Smithsonian Institution, Miss Julia Lathrop extended to Mme. Curie greetings on behalf of the scientific men and women of Washington and Dr. Robert A. Millikan, of the University of Chicago, gave an address on radium, describing the researches that led to its isolation by Mme. Curie. On the following day

Mme. Curie set in motion the machinery of the new low temperature laboratory of the Bureau of Mines, which is dedicated to her.

The degree of LL.D. has been conferred on Mme. Curie by Smith College, and she received the same degree from the University of Pennsylvania at a special ceremony arranged in her honor on May 23. The Chicago Section of the American Chemical Society has awarded to her the Willard Gibbs Medal which will be presented at a formal banquet on June 14.

SCIENTIFIC NOTES AND NEWS

Dr. Edward Bennett Rosa, chief physicist of the Bureau of Standards, died suddenly on May 17, aged sixty years.

Professor S. C. Prescott, the acting head of the department of biology and public health at the Massachusetts Institute of Technology, has sent a letter to the former students of the late Professor W. T. Sedgwick informing them of the establishment of a William T. Sedgwick Memorial Fund and asking for contributions of from five to one hundred dollars. The income of the fund will go to Mrs. Sedgwick during her life, after which the principal will go into the funds of the institute, where it will probably be used to establish a memorial professorship or some other project to encourage public health teaching and general sanitation.

Presidents of state academies of science have been elected as follows: Professor J. C. Jensen, University of Nebraska, of the Nebraska Academy of Science; Dr. D. W. Morehouse, of Drake University, of the Iowa Academy of Science; and Dr. Frank L. West, of the Utah Agricultural College, of the Utah Academy of Sciences.

Dr. F. B. Sumner, of the Scripps Biological Institution, at La Jolla, has been elected president of the San Jacinto Section of the Western Society of Naturalists.

Professor August Krogh, professor of physiology in the University of Copenhagen, recently awarded the Nobel Prize, and Dr. Clemens von Pirquet, professor of children's diseases in the University of Vienna, have been appointed Silliman lecturers at Yale University. Dr. Krogh's lectures will be connected with his recent work on the physiology of capillaries, and those of Dr. von Pirquet on undernutrition, with reference to tuberculosis in children and its treatment.

A number of engineers of the United States will hold a joint meeting with British engineers in London in July. The American engineers will present Sir Robert Hadfield on June 29 with the John Fritz medal, awarded to him in recognition of his invention of manganese steel.

We learn from *Nature* that Mr. J. E. Sears, Jr., has been appointed deputy warden of the standards in succession to Major P. A. MacMahon, who has retired under the age-limit. Mr. Sears is superintendent of the metrology department at the National Physical Laboratory, and will continue to hold this post in addition to that at the Standards Department of the Board of Trade.

In recognition of the successful laboratory research accomplished by Dr. Esmond R. Long, of the department of pathology at the University of Chicago, on "The fundamental problems in the nutrition of the tubercle bacillus," the National Tuberculosis Association, with headquarters in New York, has appropriated $4,000 for the further prosecution by Dr. Long of this work.

Professor W. H. Stevenson, head of the department of farm crops and soils in the Iowa State College and chief in agronomy and vice-director of the Iowa Agricultural Experiment Station, has been granted a year's leave of absence to accept an appointment as the representative of the United States on the Permanent Committee of the International Institute of Agriculture at Rome, to succeed Dean Thomas F. Hunt, of the University of California. Dr. P. E. Brown will be the acting head of the department in Professor Stevenson's absence.

DR. MAURICE H. GIVENS has resigned as chief of the department of biochemistry in the research laboratories of the Western Pennsylvania Hospital, Pittsburgh, Pa.

MONSIEUR BÉHAL, professor in the Paris School of Pharmacy, has been elected a vice-president and president for 1922 of the Paris Academy of Medicine to fill the vacancy caused by the death of M. Bourquelot. Professor Bénal has been a member of the Academy of Medicine since 1907, and was lately elected a member of the Academy of Sciences.

THE Council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1920–21: A Telford gold medal and a Telford premium to Mr. George Ellson (London); Telford gold medals to Sir Murdoch MacDonald (Cairo) and Dr. T. E. Stanton (Teddington); a George Stephenson gold medal to Mr. R. G. C. Batson (Teddington); a Watt gold medal to Mr. S. A. Main (Sheffield); and Telford premiums to Mr. Algernon Peake (Sydney, N. S. W.), Mr. L. H. Larmuth (London), Mr. H. E. Hurst (Cairo), Professor T. B. Abell (Liverpool), and Mr. Percy Allan (Sydney, N. S. W.).

THE observatory founded in 1913 by Sir Norman Lockyer and Lieutenant-Colonel F. K. McClean on Salcombe Hill, above Sidmouth, is henceforth to be called "The Norman Lockyer Observatory." It is proposed to place in the observatory a portrait of Sir Norman Lockyer, in the shape of a medallion, to be executed by Sir Hamo Thornycroft.

IT is announced in *Nature* that the annual meeting of the British Medical Association will be held at Newcastle-upon-Tyne on July 15–23, under the presidency of Professor David Drummond. On the occasion of the president's address on July 19 the gold medal of the association will be presented to Sir Dawson Williams, editor of the *British Medical Journal* since 1898, in recognition of his distinguished services to the association and the medical profession. In connection with the annual meeting in 1922, to be held at Glasgow, Sir William Macewen, Regius professor of surgery in the University of Glasgow, is announced as president-elect. The council of the association has recommended that the annual meeting in 1923 be held at Portsmouth.

UNIVERSITY AND EDUCATIONAL NEWS

THE Connecticut legislature is being asked for $625,000 for the State College, of which $400,000 is for a new science building for the chemical, botanical, physics, and bacteriological departments. The remainder is for maintenance during the ensuing biennium, and would be an increase from $150,000.

THE University of Virginia has received the promise of a gift of $100,000 from the Carnegie Corporation of New York on condition that the money shall be used for the purposes of permanent endowment, and that it shall be payable after there has been raised not less than $500,000 for permanent endowment from other sources.

PROFESSOR PAUL H. M.-P. BRINTON, head of the department of chemistry at the University of Arizona, has accepted appointment as professor of analytical chemistry in the school of chemistry at the University of Minnesota.

DR. CHARLES F. BROOKS, of the U. S. Weather Bureau, has been appointed associate professor of meteorology and climatology at Clark University.

DR. MEYER SOLIS-COHEN has been appointed assistant professor of internal medicine in the Graduate School of Medicine of the University of Pennsylvania.

DR. KLOTZ, of the chair of pathologic anatomy at the University of Pittsburgh, has accepted a call to the similar chair at São Paulo.

DISCUSSION AND CORRESPONDENCE

PRIMITIVE NOTIONS OF LIGHT

RELATIVE to Mr. Barton's "astonishment" (SCIENCE, April 15, page 364) that certain South American Indians do not recognize the sun as the source of daylight and his previous opinion that the Hibernicism,

Long life to the moon for a dear noble cratur
Which serves for lamplight all night in the dark,
While the sun only shines in the day which by natur
Wants no light at all as ye all may remark.

was merely a "manufactured story" without antecedent, it seems pertinent to remark that this idea of the *independence* of daylight and the sun is of great antiquity and somewhat common in early civilization.

For example, in the Hebrew story of creation we find:

. . . God said, Let there be light: and there was light. And God saw the light, that it was good; and God divided the light from the darkness. And God called the light day, and the darkness he called night. And the evening and the morning were the *first* day. (Genesis I., 3–5.)

On the second day God created the land and water and on the third day the flora. Not until the *fourth* day did God create the sun (Genesis I., 14–18) "to *divide* the day from the night," "to be for a *sign*," "to *rule* the day" and incidentally "to give light upon the earth." Also, God set the "lesser light (the moon) to *rule* the night." It also gave light upon the earth. Evidently, the "Irishman's astronomy" and that of the South American Indians are in strict and complete accord with the concepts of the author of Genesis. Quite clearly, the day was light before the sun was set to "rule" it, but the night was dark before the moon lighted it. It is not to be presumed that we can attribute any Irish wit to the author of Genesis, but it may be that the Irishman was a good orthodox churchman and, in common with many others, accepted the scripture as his authority in science. However, the Indians' concept must have been of independent origin.

Seriously, does it not appear that the ancients, even in a high degree of civilization, had only very vague and confused ideas of the relation between *light* and the sun?

Simple as it may appear to us to regard a luminous body as the source of some influence, which, acting on the eye, excites the sense of sight, much doubt appears to have existed among those who first investigated the subject as to whether objects become visible by means of something emitted by them, or by means of something issuing from the eye of the spectator.[1]

Some of the Greeks conceived vision as due to something (light?) projected from the eye.

They all [some of the Greeks] had a confused notion that as we may feel bodies at a distance by means of a rod, so the eye may perceive them by the intervention of light. It is very remarkable that this strange hypothesis held ground for many centuries, and little or no progress was made in the subject till it was established on the authority of Alhazen . . . in the *eleventh century A. D.*, that the cause of vision proceeds from the object and not from the eye.[2]

Aristotle maintained that light was not an emission from any source, but a *mere quality of a medium*.[3] This concept appears to be in substantial accord with the first light of the author of Genesis.

In spite of the existence of sun worship among many savages, it appears that our everyday commonplace concept of the sun as the primary *source* of light is of very recent origin among civilized peoples, and no astonishment need be occasioned by finding savages who have not grasped it.

Irwin G. Priest

Washington, D. C.,
April 20, 1921

A SECTION OF THE AMERICAN ASSOCIATION ON THE HISTORY OF SCIENCE

To the Editor of Science: As one of a group interested in the formation of a section on the history of science, I would venture to suggest that the inclusive nature of the designation—History of Science—is well illustrated by the use of the word "science" by the parent organization. Surely a section has the same right to include historical, philological, and other sciences, which touch the history of science under the designation—History of Science—as the parent organization has in its use of the term. The history of science touches diverse fields, and as this

[1] Preston, Theory of Light, 3rd Ed., p. 2.
[2] Preston, p. 5.
[3] Preston, p. 4.

subject becomes more intensely pursued in American Universities the contact with philology, anthropology, history, and allied subjects will increase. To group "philological science" with "history of science" is absolutely unnatural; it has an implication, apparently, that the history of science is to be studied from the philological standpoint. No one would question that philology does frequently contribute, but it can hardly be said to represent a fundamental method in the history of science.

History of science, using science with the inclusive meaning as in the title A. A. A. S., is surely the proper name for the new section now under way.

Louis C. Karpinski.

SCIENTIFIC BOOKS

The Crisis of the Naval War. By Admiral of the Fleet, Viscount Jellicoe of Scapa, G.C.B., O.M., G.C.V.O. 259 pages; 8 plates, 6 charts and appendices. George Doran Co. 1921.

This is a companion volume to Admiral Jellicoe's "The Grand Fleet, 1914–1916" which was reviewed in these columns.[1] The meeting in battle of the fleets of Great Britain and Germany was in its essence, a try-out of scientific methods of annihilation, as developed by the leading scientific nations of the world. It was said of the earlier volume that the book might aptly carry as a sub-title "Science Afloat up to 1916."

The present volume gives developments during 1917. It is not the story of a great fight like Jutland; but of undersea warfare, in which the submarine, like an assassin, struck from behind or below. Warfare on the sea had changed materially; and battleships needed screening from torpedo and mine, equally with transport and merchantman. One may well ask at this point, "Was Jutland" (in some respects the greatest naval battle ever fought; but on the whole the least decisive and most unsatisfactory) "the last great sea fight?" It seems likely; and the long line from Salamis down, draws to an end. The decisive conflicts of the future will be fought by aerial squadrons.

[1] Science, N. S., Vol. L., No. 1279, pp. 21–23, July 4, 1919.

The present volume contains 12 chapters. The first deals with Admiralty organization and tells of the changes made in 1917. The Admiral believes that specialists (which means scientific experts) should be *part* of the staff, not just attached.

He says:

> In the Army there is, except in regard to artillery, little specialization. The training received by an officer of any of the fighting branches of the Army at the Staff College may fit him to assist in the planning and execution of operations, provided due regard is paid to questions of supply, transport, housing, etc. This is not so in the Navy.

He proceeds to show that naval officers are quite a different order of being from land officers. Further discussion of this view may be omitted here. But the Admiral preaches sound gospel, so far as men of science are concerned, when he says:

> Human nature being what it is, the safest procedure is to place the specialist officer where his voice *must* be heard, that is, give him a position on the staff.

Some rather forceful remarks follow to the effect that various divisions are not to work in water-tight compartments, but must be in close touch with one another.

We notice that in the Admiralty reorganization,

> The well-known electrical consulting engineer . . . has consented to serve as director of Experiments and Research, at the Admiralty—*unpaid.*

We italicize one word and refrain from comment.

Chapter II. gives the general features of the Submarine Campaign in the early part of 1917. We are let in on certain state secrets; such as,

> "Experienced British officers aware of the extent of the German submarine building program, and above all aware of the shadowy nature of our existing means of defense against such a form of warfare" realized that the Allies "were faced with a situation fraught with the very gravest possibilities."

Throughout the chapter and also in later chapters we are given clearly to understand that the enemy submarine campaign was the gravest peril which ever threatened Great Britain.

Chapter III. tells of Anti-Submarine Operations; and while the volume lacks a dramatic climax, like Jutland, the reader whose blood runs faster because of heroic deeds, can find in this chapter stirring records of courage and defiance to the end, by the officers and men on decoy ships, drifters, trawlers and minesweepers.

Chapter IV. describes the Introduction of the Convoy System. There were not enough destroyers to give adequate protection. Requests for protection came from every quarter, but "the vessels wanted did not exist." At the end of February, 1917, the enemy had 130 submarines of all types in home waters and 20 in the Mediterranean.

A very serious situation followed the sinking of so many tankers or fuel oil ships. These vessels of great length and slow speed presented the easiest of targets for a torpedo from a submerged submarine. The reserve of oil became so perilously low that directions were issued limiting the speed of warships burning oil.

Other chapters describe the effect of the entry of the United States, the Patrol Craft and Minesweeping, Production at the Admiralty—and the Future.

The impression left on the reader is that the big fleets, big guns and big ships were to a certain degree side-tracked; and that the smaller units did most of the work and were the effective factors in winning the war. The Admiral clearly indicates this in an eloquent passage on page 188.

> I regret very deeply that in spite of a strong desire to undertake the task, I have neither the information nor the literary ability to do justice to the many deeds of individual gallantry, self-sacrifice and resource performed by the splendid officers and men who manned the small craft. No words of mine can adequately convey the intense admiration which I felt and which I know was shared by the whole Navy for the manner in which their arduous and perilous work was carried out. These fine seamen though quite strange to the hazardous work which they were called upon to undertake quickly accustomed themselves to their new duties; and the Nation should ever be full of gratitude that it bred such a race of hardy, skilful and courageous men as these who took so great a part in defeating the greatest menace with which the Empire has ever been faced.

The references to the American Navy, and in particular to Admiral Sims, are most complimentary. The laying of the mine barrage from Scotland to Norway indicates how far modern warfare at sea has changed since the days when Captain Mahan wrote his treatise on "Sea Power."

In the future, the seaplane, greatly developed of course from its present stage, will be the effective unit, both in offense and defense. With perhaps more truth the words of the Admiral regarding specialized training will hold for officers of the Air Service.

Alexander McAdie

Diseases of Economic Plants. By F. L. Stevens. New York, The Macmillan Company.

This is a revised edition of a former work under the same title by Stevens and Hall. It will be welcomed not only by the professional botanists, but also by a very large number of teachers, county farm demonstrators and others who are finding plant pathology a subject of increasing interest and importance. The importance of plant diseases and the very rapid progress of plant pathology makes frequent revision of a work of this kind imperative. The general plan of the work is very similar to the original edition but is somewhat enlarged and has been brought up to date. The author pays a pleasing tribute to our American workers by inserting the pictures of Farlow, Burrill, Halsted, Bessey, Atkinson and E. F. Smith, who are so well known to all students of mycology and plant pathology.

The discussions are arranged with reference to the crops on which the diseases occur. The diseases are grouped mostly with reference to

the crops on which they occur and are subdivided into diseases of major and minor importance. This arrangement is especially serviceable to those who are not specialists on plant diseases. The descriptions of the symptoms are brief, clear and very readable. There is no attempt whatever to discuss the organisms which are the causes of these diseases but references are given to some of the more important publications. Each disease is designated by its common name; the scientific name for both the imperfect and the perfect stages, where known, are placed in parenthesis. The book also contains chapters on the history of the subject, damages due to plant diseases, prevention and cure, general diseases which attack a large number of crops, fungicides and soil disinfection. The chapter on cost of spraying which was in the first edition is very properly omitted since this is a varying factor dependent on cost of materials and labor.

The work is intended primarily as a textbook and it will prove of great service to all teachers of plant pathology. Possibly its greatest value lies in the brief, clear descriptions which are of such great importance in making diagnoses of diseases in the field. The student of mycology will also find it an important supplement for his work on economic forms. The horticulturists, nurserymen, county farm demonstrators, progressive farmers and in fact all others who are interested in the applications of agriculture will find it an extremely useful reference book.

The mechanical make-up of the work is good except for the crowded arrangement of the bibliography which would lead any one who uses it to fear that the supply of paper is exhausted.

Mel T. Cook

New Jersey Agricultural Experiment Station

SPECIAL ARTICLES

THE Y-CHROMOSOME IN MAMMALS

The majority of workers on mammalian spermatogenesis have described the sex-chromosome as being of the X-O type but recent investigations in this field by the author indicate that the X-Y type of chromosome may be more common than is generally thought.

In the opossum,[1] an animal for which the X-O type of sex-chromosome has been described, the writer finds a typical X-Y sex-chromosome complex. Both the X and Y components may be recognized in spermatogonial and somatic divisions because of their distinctive size. In the first maturation division the X and Y elements segregate apart to opposite poles of the cell, and in the second maturation division both divide equationally. Hence half of the sperm carry an X and half carry a Y chromosome.

The diploid chromosome number for both the male and female opossum is 22, and not 17 or 24 as concluded by previous investigators.

In the testes of both the white man and the negro I have found in the first spermatocytes a chromosome pair which is similar in appearance and behavior to the X-Y chromosome of the opossum. The two members of this pair, in the human, representing the X and Y components, are unequal in size; they segregate apart in the first maturation division just as in the case of the opossum.

It will be of general interest to biologists to know that the diploid number of chromosomes for man is very close to the number (47) given by Winiwarter.[2] In my own material the counts range from 45 to 48 apparent chromosomes, although in the clearest equatorial plates so far studied only 46 chromosomes have been found. Before a final conclusion is made on the exact number it is desired to make a careful study of a large number of division plates. There can be absolutely no question, however, but that the diploid number of chromosomes for both the white man and the negro falls between 45 and 48. With the X-Y type of sex-chromosome we

1 The writer's work now in press.

2 Winiwarter, H. von, 1912, *Arch. de Biol.*, Vol. 27.

may expect an even number, that is, either 46 or 48.

My material to date includes the testes of one white man and of two negroes. All individuals were castrated because of self abuse, at one of the Texas state institutions. The testes were removed with the use of local anæsthetics and immediately preserved in Bouin's fluid, to which chromic acid and urea had been added. In less than a minute after removal from the body the germ-cells were being bathed in the fixing fluid. The preservation thus obtained is very satisfactory.

In view of the uncertainty which has existed regarding the chromosome number in man, the author will gladly send samples of this human material to any experienced cytologist in order that the latter may verify for himself the correctness of the chromosome counts given. The complete spermatogenesis of man is being reworked by the writer at the present time and his results will be published in the near future.

Theophilus S. Painter

University of Texas,
Austin, Texas

THE ROCHESTER MEETING OF THE AMERICAN CHEMICAL SOCIETY

The sixty-first general meeting of the American Chemical Society was held at Rochester, N. Y., from April 25 to April 29, inclusive. The council meeting was held on April 25, the general meeting on the morning and afternoon of the twenty-sixth, divisional meetings all day Wednesday and Thursday, and excursions on Friday. Full details of the meeting and program will be found in the May issue of the *Journal of Industrial and Engineering Chemistry*. The registration was 1,139, and 1,270 sat down to dinner at the good fellowship meeting.

General public addresses were given by Senator James W. Wadsworth, Jr., on "Some Problems of National Defense," and by Congressman Nicholas Longworth, on "The American Chemical Industry and its Need for Encouragement and Protection." At the general business meeting held Tuesday morning, April 26, Charles F. Chandler and William H. Nichols were unanimously elected honorary members of the society. The chief public address was given at Convention Hall on Wednesday evening, April 27, by Charles F. Chandler, on "Chemistry in the United States." At the general meeting on Tuesday afternoon, the following general papers were presented:

"Ammono carbonic acids," by E. C. Franklin.

"The measurement of color," by C. E. K. Mees.

"Blue eyes and blue feathers," by W. D. Bancroft.

"Surface Films as Plastic Solids," by R. E. Wilson.

"The relation between the stability and the structure of molecules," by Irving Langmuir.

"Ionization of electrolytes," by G. N. Lewis.

The following divisions and sections met: Divisions of Agricultural and Food Chemistry, Biological Chemistry, Chemistry of Medicinal Products, Dye Chemistry, Industrial and Engineering Chemistry, Organic Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, and Water, Sewage and Sanitation; Sections of Cellulose Chemistry, Petroleum Chemistry and Sugar Chemistry and Technology. Further details of their meetings will be found in the May issue of the *Journal of Industrial and Engineering Chemistry*.

Tuesday evening was given up to dinners and gatherings of various colleges and fraternities. On Thursday evening the good fellowship meeting, complimentary to the members of the Rochester Section, consisted of a dinner in the Bausch and Lomb dining hall, followed by a varied and interesting program consisting of music, vaudeville entertainment, motion pictures of the convention itself and prominent members thereof, and a film shown for the first time, picturing the operations of the Eastman Kodak Company. The scientific program was the most extensive ever presented before a meeting of the American Chemical Society and consisted of 280 papers.

Charles L. Parsons,
Secretary

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THE DUTY OF SCIENTIFIC MEN IN CONSERVATION[1]

THE conservation movement of a few years ago crystallized and brought to public attention a great principle, one so far reaching that its real significance and scope are even to-day not generally grasped. Regardless of how the term may be defined, the problem of conservation involves the whole question of the relation of our natural resources to the economic life and upbuilding of the country. We have to do not merely with the prevention of waste and economical use of our resources, but also with the problem of how these resources may render their highest service in building up local communities, maintaining our industries, and contributing to a strong civilization.

We can point to considerable progress in certain features of conservation during the past decade. Scientific men have conducted research of great value that already is resulting in new uses of various raw materials, in more economical methods of handling them, and in improved methods of perpetuating those resources which are renewable; engineers are giving more attention than formerly to the problem of preventing unnecessary losses in the exploitation of raw resources; the more far-sighted leaders of industry have an increasing appreciation of the relation of natural resources to the permanence of their own enterprises. And yet, the conservation principle is making slow headway, when viewed from the larger aspects of the economic needs of the country. The loss through unnecessary waste is still appalling, uneconomic methods in the use and development of various

[1] This paper was presented at a joint meeting on April 9, of three Committees on Conservation, representing the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science.

of the resources continue, and the interests of industries and communities are already in many cases jeopardized by the depletion of local sources of raw material.

Among the obstacles to the more rapid application of the principles of conservation are ignorance and indifference on the part of those engaged in developing natural resources, unwillingness to change old methods, and selfishness of individuals who are willing to sacrifice even the interests of their own industry to immediate gains. But there are also obstacles of an economic and public character, that are retarding progress. These relate to the character of ownership and control of natural resources, to the existing organization of certain of the industries, to problems of transportation, and in some cases to questions of taxation and the relation of the public to industry.

Scientific research furnishes the foundation of conservation. Education will solve the problem of ignorance and indifference. The economic and political obstacles, however, can usually be overcome only through action by the public. Thus it is that those who are engaged in promoting the principles of conservation in their respective fields are urging legislation in the federal Congress and in state legislatures, seeking public aid for private owners of resources and for the industries, public cooperation in marketing and distribution, public action in road building and other transportation problems, and in some instances public control over the basic resources themselves, over their exploitation, or over the distribution of their products.

In studying the situation in the different fields of conservation, I have been increasingly impressed by the inadequacy of the available information about the different resources in their relation to the problems of our national development. This may be surprising in view of the extensive research in different branches of science, and the large amount of reliable data in regard to the quantity of the various resources, their basic qualities, their possible uses, and the general requirements of American industry. Yet this information has not been assembled and interpreted in a way to show the real meaning of our resources and their conservation to the permanent advancement of our industrial and social life.

Not long ago I asked a prominent leader of forestry in Massachusetts if anyone could inform me just what the forests in that state mean to its permanent economic life; the relation of the forests to wood-using industries, their importance in maintaining successful agriculture, their relation to transportation, to rural life, and to the labor problem of the state. The answer was that no such comprehensive study had ever been made. In that state as elsewhere, the discussion of forestry has centered chiefly about the problem of the production of board feet for the market. The economic aspects of forestry as a land problem have been subordinated or overlooked. Forestry concerns the use and development of nearly one third of the area of the entire country. We have the problem of whether this vast area shall be of service in building up and maintaining permanent rural communities, with all the resulting benefits to the state and to the nation. When our forest problem is studied in its relation to the concrete economic needs of the localities where the resources are located, it takes on a new aspect, it reveals a more alarming situation than if it concerned only the question of a supply of specified products, and it calls for different considerations in public policy.

Our economic studies of natural resources have thus been too restricted in their viewpoint, often overlooking aspects of great importance in formulating policies. This is especially true where the service of one natural resource is dependent upon the development and right handling of another. It is the general rule that a state or a locality is not built up on the basis of a single resource. Its economic prosperity depends upon many branches of industry using various resources some of which are obtained locally. A permanent industrial organization depends upon the right handling of all the various natural resources. The development of one may be dependent upon others; the destruction of one may re-

tard or entirely prevent further progress in the region. No better example of this principle can be found than agriculture and forestry. In many regions the forest is essential to permanent agriculture. Where the land is largely of high quality, agriculture can be carried on as an independent enterprise; where poor land predominates, successful agriculture depends upon the development of other natural resources in the region. It was the forest and the forest industries that made farming possible in many of our lean-land regions. When the forest was destroyed, and the lumber and auxiliary industries moved out, the farms were abandoned or continued under great difficulties. The forest is often regarded only as a temporary cover which is to be removed to make way for agriculture or other industrial use of the ground.

It is assumed that settlement will take place after the forest has been destroyed. Precisely this situation exists in the pine region of the South. The forests are being cleared away with great rapidity, with almost no effort to replacement. Every tree is cut that will make a log, including the young timber that has grown since the Civil War; and many thousands of acres of small trees 25 years or so of age, are turpentined under methods that will kill them within a few years. The owners then undertake to dispose of the lands for farming. The public is appealed to for cooperation in attracting settlers, and to establish colonies of farmers upon these devastated areas. If this land were of the character of that in the Mississippi and Ohio valleys, the effort would be more successful. But only a part of the land is fertile, and that is intermixed with light soils suited only to tree growth. The raising of live stock will help this situation to some extent, just as it was a great factor in the early settlement of Virginia, Kentucky, Tennessee, and other states. But in the long run it will be the forest, growing on the poor soils, that will supplement farming and stock raising and, by affording additional opportunities to the farmer and by supporting local forest industries, will make the settlement successful and permanent.

You have doubtless, most of you, visited the Landes district of southwestern France. This is an extensive sandy plain, presenting conditions similar in many respects to the coastal plain of our South. The original pine forests were destroyed, and the whole region remained for many years in a backward condition. Prior to the middle of the last century this whole area, through the initiative and cooperation of the government, was reforested. The direct result was that the tillable lands, often in small areas, were cultivated and a prosperous rural organization built up. The farmers were able to devote a part of their time to logging, to turpentining, and to work in the mills. All of the land is in use, furnishing several resources that altogether support an astonishingly large population.

I am in sympathy with the efforts to attract settlers to the South and other cut-over land districts. I am in sympathy with the plans for public cooperation in land classification. I am in sympathy with public encouragement of systematic establishment of farm colonies, even with public help as is successfully done in California. But first of all we must stop the wasteful destruction of the very resources that are necessary to make such settlement work successful. And that can be done only by a recognition of the interrelation of the problems of the various resources, and the working together of all of them to the common end of building up the country.

Many other illustrations could be given of two or more resources which are interdependent and whose problems of development and conservation cannot be considered separately without loss. Forestry and stock-raising, farming and mining, agriculture and mining, forestry and recreation, wild life conservation and grazing, water resources and forestry, water power, oil and coal, are a few examples. Oftentimes too there is a failure to consider the larger aspects of resource development in the planning and building of highways. Transportation is one of the largest factors in removing the economic obstacles to successful conservation. In the past great sums have been expended on unwisely planned roads.

Every public officer charged with selecting road routes, is subject to enormous pressure to build specific roads in aid of special industrial groups or individual interests. This was brought home to me when, during my service as head of the Forest Service, we inaugurated a large enterprise of public highways in the National Forests. In working out a policy of public highways the selection of projects and planning of the roads were based upon studies of all the various natural resources and of the local economic needs. Every road was to render its highest service in aid of resource development, in building up and maintaining permanent communities; and in this we did not overlook the encouragement of outdoor recreation through conserving the scenic values along the routes.

One of the most important problems before our country to-day is to preserve and build up a strong rural civilization. Every one at all familiar with our economic history appreciates the influence on our physical prosperity and upon the moulding of American character of the existence of a vast public domain containing a wealth of natural resources of great variety and readily available for use. It was through this surplus of resources that there was developed among our people the qualities of individuality, initiative, and self-reliance. Our national strength lies in having a great number of small land proprietors, of small entrepreneurs in all industries, an army of men dependent upon their own individual efforts rather than upon mass organization. It is for this reason that we are seriously concerned by the movement away from the country to the industrial centers, and by the increase of ratio of the industrial to the rural population. Our public domain is now but a fragment and is no longer available as a factor in assimilating the great number of aliens that are flocking to our shores. The resources that can readily be developed by the individual are approaching exhaustion; the surface cream of our natural wealth has been skimmed off.

We still possess vast resources, but their development involves new problems. The process of exploiting the more accessible resources built up a rural organization. In many cases this has broken down or its character has been changed. The building up of a sound rural civilization on a permanent basis depends first of all on how we work out the new problems of handling our natural resources.

I would not in any degree minimize the problem of conservation as it relates to the supply and distribution of raw materials for our various industries. The need of conservation from this aspect has been borne in upon our industries by the artificial shortage created by conditions growing out of the war. Less appreciated is the relation of conservation to the welfare of the localities where the natural resources occur, and it is for that reason that I have to-day laid stress upon that special feature.

The efforts in conservation to-day are scattered among a large number of institutions, organizations, and individuals. There is a lack of unified purpose and direction in the movement. Workers in separate fields fail to give adequate consideration to the bearing of the problems of other resources upon their own. Oftentimes there is an actual conflict of interests in the use and development of two or more resources that is not being adjusted and is leading to public injury. In the field of public policy many proposals are being made, each perhaps with a good purpose, which are not in harmony as to principle and often are in conflict, with resulting confusion to the public and frequent failure to secure the legislation requested.

To-day there is no central agency, governmental or otherwise, that is considering our natural resources as a whole in their relation to our economic, industrial, and social development. There is no leadership in conservation in its larger aspects, that defines objectives, assembles and interprets the basic data regarding our resources, works out the principles of harmonizing conflicting interests in resource development, that furnishes, in short, the economic background for conservation and the principles that must underlie the public action necessary to make our natural resources render their best service; and there

is no agency equipped to organize the educational work that should be introduced into our colleges and schools, aside from popular education in conservation.

It must be clear to every student of the natural resource problem that there is an undertaking in conservation of great magnitude awaiting leadership and organized effort. There is an opportunity and, in my opinion, a duty for the great national organizations of scientific men to join hands in assuming this leadership. They are in a position to bring into harmony the objectives, the policies, and the efforts of those working in the several branches of natural resources. Under their guidance and inspiration there could be assembled the available information regarding our natural resources, and the interpretation of the problems of conservation from the broad viewpoint of the relation of all resources to our national development. The scientific organizations would thus be able to contribute to the formulation of public policies, and to aid in bringing about their adoption. And finally, it would be possible for them through existing agencies to carry out an educational plan for the introduction of appropriate studies in conservation in our schools and colleges, and to forward a far-reaching campaign of popular education.

The appointment of conservation committees by the National Academy of Sciences, the National Research Council, and the Association for the Advancement of Science, and the meeting of these committees for the consideration of joint action, should prove to be the first step in a new leadership that will give power to the conservation movement, with the promise of very large achievement.

In my opinion a very great responsibility rests upon this conference. We have an opportunity to organize the intellectual forces of the country in a movement that will have a profound influence upon the future well-being of the country. Our action may determine the direction the movement may take, and whether it will be effective or lag behind for lack of leadership. A great public interest depends upon our foresight and vision, upon our ability to plan with wisdom.

HENRY S. GRAVES

PRESIDENT HARDING'S PRESENTATION ADDRESS TO MME. CURIE

Mme. Curie: It is with an especial satisfaction that I perform the pleasant duty which has been assigned to me to-day. On behalf of the American nation I greet and welcome you to our country, in which you will everywhere find the most cordial reception. We welcome you as an adopted daughter of France, our earliest supporter among the great nations. We greet you as a native born daughter of Poland—newest, as it is also among the oldest of the great nations, and always bound by ties of closest sympathy to our own Republic. In you we see the representative of Poland, restored and reinstated to its rightful place; of France, valiantly maintained in the high estate which has ever been its right.

As a nation whose womanhood has been exalted to fullest participation in citizenship, we are proud to honor in you a woman whose work has earned universal acclaim and attested woman's equality in every intellectual and spirtual activity.

We greet you as foremost among scientists in the age of science, as leader among women in the generation which sees woman come tardily into her own. We greet you as an exemplar of liberty's victories in the generation wherein liberty has won her crown of glory.

In doing honor to you we testify anew our pride in the ancient friendships which have bound us to both the country of your adoption and that of your nativity. We exalt anew our pride that we have stood with them in the struggle for civilization, and have touched elbows with them in the march of progress.

It has been your fortune, Mme. Curie, to accomplish an immortal work for humanity. We are not without understanding of the trials and sacrifices which have been the price of your achievement. We know something of the fervid purpose and deep devotion which in-

spired you. We bring to you the meed of honor which is due to preeminence in science, scholarship, research and humanitarianism. But with it all we bring something more. We lay at your feet the testimony of that love which all the generation of men have been wont to bestow upon the noble woman, the unselfish wife, the devoted mother. If, indeed, these simpler and commoner relations of life could not keep you from attainments in the realms of science and intellect, it is also true that the zeal, ambition and unswerving purpose of a lofty career could not bar you from splendidly doing all the plain but worthy tasks which fall to every woman's lot.

A number of years ago a reader of one of your earlier works on radioactive substances noted the observation that there was much divergence of opinion as to whether the energy of radioactive substances is created within those substances themselves, or is gathered to them from outside sources and then diffused from them. The question suggested an answer which is doubtless hopelessly unscientific. I have liked to believe in an analogy between the spiritual and the physical world. I have been very sure that that which I may call the radioactive soul, or spirit, or intellect—call it what you choose—must first gather to itself, from its surroundings, the power that it afterward radiates in beneficence to those near it. I believe it is the sum of many inspirations, borne in on great souls, which enables them to warm, to scintillate, to radiate, to illumine and serve those about them. I am so sure of this explanation for the radioactive personality that I feel somehow a conviction that science will one day establish a like explanation for radioactivity among inanimate substances.

Perhaps, in my innocence of science, I am airily rushing in where scientists fear to tread. But I am trying to express to you my conviction that the great things achieved by great minds would never have been wrought without the inspiration of an appealing need for them. That appeal comes as inspiration to successful effort, and success in turn enables the outgiving of benefits to millions whose only contribution has been the power of their united appeal.

Let me press the analogy a little further. The world to-day is appealing to its statesmen, its sociologists, its humanitarians and its religious leaders for solution of appalling problems. I want to hope that the power and universality of that appeal will inspire strong, devout, consecrated men and women to seek out the solution, and, in the light of their wisdom, to carry it to all mankind. I have faith to believe that precisely that will happen, and in your own career of fine achievement I find heartening justification for my faith.

In testimony of the affection of the American people, of their confidence in your scientific work, and of their earnest wish that your genius and energy may receive all encouragement to carry forward your efforts for the advance of science and conquest of disease, I have been commissioned to present to you this little phial of radium. To you we owe our knowledge and possession of it, and so to you we give it, confident that in your possession it will be the means further to unveil the fascinating secrets of nature, to widen the field of useful knowledge, to alleviate suffering among the children of man. Take it to use as your wisdom shall direct and your purpose of service shall incline you. Be sure that we esteem it but a small earnest of the sentiments for which it stands. It betokens the affection of one great people for another. It will remind you of the love of a grateful people for yourself; and it will testify in the useful work to which you will devote it, the reverence of mankind for one of its foremost benefactors and most beloved of women.

HENRY PLATT CUSHING

The death of Professor Cushing in the month of April last at his home in Cleveland, has already been announced in these columns. His colleagues on the Geological Survey of New York wish to pay the following brief tribute to his friendship and worth. His scientific work is a part of the enduring records of the survey with which he was associated for twenty-eight years. His name will be forever

associated with the scientific exploration of the Adirondack Mountains, the most picturesque part of the State of New York, the great playground of the people of this and other states. In 1893 Cushing, with James F. Kemp and C. H. Smyth, Jr., entered this difficult field for the purpose of intensive investigation of its geological structure. For more than one generation it had been a common remark among intelligent people that the Adirondacks were "the oldest rocks on earth," but except in broadest features their structures were not understood or the relations of their mountain-making rock masses, one to another, comprehended. Professor Kemp, conceiving the importance of a systematic attack on this resistant field where geological information had lagged so far behind the rest of the state, brought together this little trinity of workers under the auspices of the state survey and its joint activity continued for many years; and though the attack eventually became a desultory one by two of the three, Cushing's part went on without interruption. He was a fine geologist in a difficult field, keen, patient, with the factors of his problem fully in hand; an excellent petrologist with a perfectly competent understanding of the dynamics of the Precambrian rocks. His grasp of the complicated Precambrian history of New York and the succession of events composing it finally enabled him to tell the story in his "Geology of the Northern Adirondacks." From the beginning of his field work in New York Professor Cushing showed that he was quite as competent to carry on the work in the unaltered sedimentary rocks, even in the intensive way which present requirements demand. He was a manly, frank, open-hearted and devoted student of his science, who challenged respect for his work and engaged the deep attachment of those who were admitted to his friendship.

JOHN M. CLARKE

WHEN Cushing began his work in the Adirondack region in 1893 the pre-Cambrian rocks, excepting the area in which Kemp was working, had been studied only very locally or by the aid of antiquated methods which led to quite erroneous conclusions. An assemblage of crystalline limestone, quartzites, schists and gneisses was clearly of sedimentary origin, while certain massive rocks were as clearly igneous. There were also extensive areas of gneisses and schists of doubtful origin. To determine the origin of these rocks, together with the structural and age relations of the various formations, was the fundamental problem. Working at first in the northeastern part of the region, Cushing had to deal mainly with rocks that proved to be igneous, and he was able to establish not only their origin but also, to a large extent, their time relations, and particularly that of the very extensive anorthosites and syenites. The work was later extended to the southern edge of the Adirondacks and, finally, to the northwestern part, his last paper being a report on the Gouverneur quadrangle, now in press.

In this district he came in contact with extensive areas of the Grenville sedimentary series, and worked out in detail their relations to the granites, syenites and gabbros. In this work he emphasized the relatively slight erosion of the crystalline rocks as compared with districts to the east, with the resultant partial, or complete, survival of the roofs of batholiths. In the course of these years of field and laboratory study he gathered a great mass of data which afforded the basis for important papers dealing with differentiation, assimilation, and other petrologic problems. In this work he was greatly aided by a series of highly accurate analyses of rocks made for him by his friend, Dr. E. W. Morley.

One can not look over Cushing's publications on the Adirondack region, even casually, without being impressed by the great volume of work represented, and the wide range of problems treated. The more carefully his papers are studied, the more evident is the wealth of accurate observation and carefully reasoned conclusions contained in them. They constitute a brilliant record of achievement in a difficult field of research.

C. H. SMYTH, JR.

Although Professor Cushing was primarily interested in Precambrian lithology and stratigraphy, he was led into stratigraphic investigation of the Paleozoic formations by his work along the margin of the Adirondack massive and his desire to read the history of this region from the overlapping and surrounding Paleozoic rocks. He was a pioneer in this work, and by his method of carefully noting and comparing the lithologic characters, relative thicknesses and amounts of overlap on the Precambrian, as well as the fossil contents of the various Paleozoic formations, he was able to trace the unequal emergences and submergences of the different sides of the Adirondack massive.

He began at the northeast corner of the Adirondacks, in Clinton county, where he early recognized the great thicknesses of the Potsdam and Beekmantown formations and their thinning westward and southward, implying the more rapid and steady subsidence of the northeastern part of the Adirondacks in Late Cambrian and Early Ordovician time. Then at the southwest corner he found the successive overlap of the Ordovician formations, notably of the Beekmantown and Trenton, upon the comparatively even Precambrian floor and thus inferred a relatively even sinking of this side of the Adirondacks in Early and Middle Ordovician time, interrupted by an elevation in Chazy time.

In the "Geology of the Northern Adirondack Region" the Paleozoic history of the Adirondacks is for the first time treated logically by a comparison of the Paleozoic deposits on all four sides. This work also showed Cushing where correct data were still lacking for a more comprehensive treatment of his subject. These data were supplied by his later work (jointly with Ulrich and Ruedemann) on the Paleozoics of the Thousand Islands (northwest corner), Saratoga Springs (northeast corner) and Ogdensburg (north side) regions. It was his intention to continue the work in the Watertown region together with Ruedemann. Jointly with these co-workers he reached the conclusion that the Paleozoic rocks which rim the Adirondacks consist largely of the thinner, near-shore edges of a great number of formations, and that there is a great lack of correspondence between the formations on the different sides. This conclusion found its expression in a more refined distinction and correlation of formational units in the Paleozoic rocks surrounding the Adirondacks.

Cushing's stratigraphic work has left its indelible impress upon the elaboration of the geologic history of New York. He was equally keen and enthusiastic in studying the lithologic and structural, as well as the stratigraphic and faunistic characters of the formations; and those who had the good fortune to be associated with him in the field will never forget his vigorous sterling character, cautious and fair weighing of all evidence, and his fine sense of humor.

R. Ruedemann

SCIENTIFIC EVENTS

AN ENGLISH HOSPITAL FOR NERVOUS DISORDERS

We learn from the London *Times* that Sir Ernest Cassel has given £225,000 to found and endow a hospital or sanatorium for the treatment of functional nervous disorders, and the King and Queen have consented to become patrons of the new institution. Sir Ernest Cassel has purchased a fine mansion and park in ideal surroundings at Penshurst, Kent, for the purpose. The house, which has been reconstructed, will accommodate about 60 patients, and was opened on May 23.

By the term "functional nervous disorders" will be understood those common but complex and distressing conditions which are not the direct outcome of organic disease. Among such may be named neurasthenia, nervous break-down, loss of power not associated with evident structural changes, together with those manifold kindred troubles which are loosely termed "nervous." Largely the result of the stress and turmoil of modern life, they are unfortunately of great frequency and are accompanied by much suffering, and followed, not uncommonly, by disastrous mental and physical consequences. Subjects of these dis-

orders often become incapacitated and remain so for want of the particular treatment they require. For such treatment scarcely any facilities exist at the present moment. To say that a condition is merely due to "nerves" has been almost equivalent to saying that it calls for nothing beyond rest and change. These disorders are, however, amenable to medical treatment under favorable conditions, and it is to provide such means of cure and further to expand and elaborate them that the present institution has been founded.

The hospital is primarily intended for those members of the educated classes who are unable to meet the heavy expenses associated with care and treatment in a nursing home. The upkeep of the institution and the treatment of the patients have been largely provided for by the generosity of the founder, but a charge will be made to each patient as a contribution to his or her maintenance.

The members of the general committee, under the chairmanship of Sir Ernest Cassel, are Sir Robert Hudson, Sir Courtauld Thomson, Sir Felix Cassel (the trustees of the fund), and Mrs. Joshua, together with the members of the medical committee, Miss Aldrich-Blake, M.S., Dr. Farquhar Buzzard, Sir Maurice Craig, Lord Dawson, Professor J. S. Haldane, Dr. Henry Head, Dr. A. F. Hurst, and Sir Frederick Treves. Dr. T. A. Ross, who has had a wide experience of diseases of the nervous system, has been appointed medical director.

THE GIFT TO MME. CURIE

THE deed of gift, which accompanied the gram of radium presented to Mme. Curie by President Harding on May 27 reads:

This agreement, made this 19th of May, 1921, between the Committee of Women of the Marie Curie Fund, of 3 Macdougal Street, New York City, and Mme. Curie, of Paris, France, witnesseth:

WHEREAS a gram of radium has been secured through the efforts of the above mentioned committee and by the voluntary subscriptions of the women of the United States for the purpose of presentation to Mme. Marie Curie for free and untrammeled use by her in experimentation and in pursuit of science,

Now, therefore, in consideration of the object above set forth and in order that the fullest scientific use may be made of such material, the said executive committee of the Mme. Curie Fund, as representing the subscribers thereto, does hereby give, grant and transfer to Mme. Marie Curie the said gram of radium, to be used and applied by her freely and in her discretion in experimentation and in the best interests of science by herself personally, or under her direction or through such agencies, assistants and successors as she may nominate, and in the confident expectation that Mme. Curie will take measures as will insure the continued use of the said material for the purposes stated, in case of her withdrawal from activities or other disability through such persons as she may adjudge best qualified for the purpose.

RUINS IN THE UPPER CANADIAN VALLEY

IN March and April, Messrs. W. K. Moorehead and J. B. Thoburn travelled through the Upper Canadian valley and the Panhandle of Texas and eastern New Mexico, continuing the explorations begun last spring in that region. They discovered that the small buildings and house foundations which are supposed to have marked the beginning of the Pueblo-Cliff Dweller culture extended through New Mexico to the foot of the continental divide. In the Mora valley they found seven or eight small ruins and one L-shaped structure 200 x 150 feet which were distinctively Pueblo. On the surface, and by means of excavation, broken pottery of black and white design was found. This was archaic Pueblo—the earliest type. In Ute and La Cinta canyons were found rock shelters and caverns which had been inhabited by Indians. Many more petroglyphs were also discovered.

The results of this expedition are said to confirm the observations made last year to the effect that a new field in American archeology has been opened and that Indian remains extend through a territory approximately 250 x 150 miles.

GEOLOGICAL EXPEDITION TO CHINA

A PARTY of six geologists and mining engineers from Minnesota and Wisconsin, includ-

ing Professor W. J. Mead, of the department of geology, W. R. Appleby, of the school of mines, University of Minnesota; Professor W. H. Emmons, University of Minnesota; Frank Hutchinson, consulting engineer, Duluth, Minn.; L. D. Davenport, mining engineer, Hibbing, Minn.; and W. H. Graigo, mining engineer, recently of South Africa, of the University of Wisconsin, will go to China this summer as consulting experts for the South Manchuria Railway company. The party will sail from Seattle early in June and return in October. Professor Mead writes:

The South Manchuria Railway company controls partly developed iron and coal deposits near Mukdan, South Manchuria. The iron deposits resemble geologically those of the Lake Superior region. The railway company has employed a group of technical men familiar with the Lake Superior iron mining industry to make a thorough investigation of the Manchurian deposits during the coming summer and to advise on the best methods of opening up and developing both the iron ore and the coal.

EXPEDITION TO THE UPPER BASIN OF THE AMAZON

An expedition to the headwaters of the Amazon River, under the leadership of Dr. H. H. Rusby, dean of the school of pharmacy of Columbia University, will sail for Antofagasta, Chile, on June 1. The main object of the expedition, which is financed by the H. K. Mulford Company, is the collection of herbs and plants likely to be of use in medicine, but studies will be made of the fauna and flora of the region.

Dr. Frederick L. Hoffman, statistician and vice-president of the Prudential Life Insurance Company, will accompany the expedition to make a study of health conditions with a view to the possibility of the acclimatization of white men in the region. Other members of the expedition are: Dr. William M. Mann, assistant entomologist of the Bureau of Entomology of the U. S. Department of Agriculture, in charge of entomology; Dr. Everett Pearson, University of Indiana, in charge of ichthyology; Dr. Orland E. White, of the Brooklyn Botanical Garden, representing Harvard University, in charge of botany; and George S. McCarthy, of Woodbury, N. J., taxidermist.

From Antofagasta, the expedition will travel by way of the Guggenheim mining properties to La Paz, Bolivia. From La Paz it will pass through unexplored territory, crossing the Andes at an elevation of more than 19,000 feet. Calomar will be used as a base for the expedition.

SCIENTIFIC NOTES AND NEWS

The Royal Society on May 5 elected as foreign members Dr. Albert Calmette, of the Pasteur Institute; Dr. Henri Deslandres, of the Paris Observatory; Professor Albert Einstein, of the University of Berlin; Professor Albin Haller, of the University of Paris; Professor E. B. Wilson, of Columbia University, and Professor P. Zeeman, of the University of Amsterdam.

Professor George C. Whipple, of the Harvard Engineering School and the Harvard Technology School of Public Health, has been elected an honorary fellow of the Royal Sanitary Institute of Great Britain.

Dr. Otto Klotz, director of the Dominion Observatory, Ottawa, has been elected president of Section III. (Mathematical, Physical and Chemical Sciences) of the Royal Society of Canada.

The following officers were elected at the annual meeting of the Kentucky Academy of Sciences on May 14:

President, George D. Smith, Eastern Kentucky State Normal School, Richmond, Ky.

Vice-president, Lucien Beckner, Winchester, Ky.

Secretary, A. M. Peter, Experiment Station, Lexington, Ky.

Treasurer, Chas. A. Shull, University of Kentucky, Lexington, Ky.

Member of Publications Committee, D. W. Martin, Georgetown College, Georgetown, Ky.

Representative in the Council of the American Association for the Advancement of Science, A. M. Peter.

Dr. A. R. Mann, dean of the New York State Agricultural College at Cornell Uni-

versity, has declined the post of New York State Commissioner of Agriculture, to which he was recently appointed by the State Council of Farms and Markets.

Robert C. Duncan, physicist at the Bureau of Standards, has resigned to accept a position as technicist for the Bureau of Ordnance, Navy Department.

Mr. B. H. Rawl, assistant chief of the Bureau of Animal Industry, U. S. Department of Agriculture, has resigned to take charge of the educational work of the California Central Creameries, with headquarters in San Francisco.

Dr. W. K. Gregory sailed for Sydney, New South Wales, on May 31, to enlist the cooperation of Australian museums with the American Museum of Natural History and to secure material for the Australian Hall of the Museum.

Mr. W. L. G. Joerg, of the scientific staff of the American Geographical Society of New York and editor of its Research Series, left on May 21 on a six months' leave of absence for a trip to Europe on behalf of the society to study the present status and tendencies of geography in Europe and to establish closer relations with kindred workers and institutions.

Dr. H. H. Whetzel, head of the department of plant pathology at Cornell University, has been granted sabbatical leave for the year 1921–22. He will sail on June 8 for Bermuda, where he is to be associated with the Department of Agriculture of the Islands in plant disease survey and research work. Dr. L. M. Massey will be acting head of the department in the absence of Professor Whetzel.

A botanical garden, established as part of Albany's park development program in cooperation with the Albany College of Pharmacy, which will contain every plant grown in the state, is included in the new college plans. According to Dean Mansfield, the garden will be one of the most complete of its kind in the United States and will be arranged after the plan of the London and Paris botanical parks.

UNIVERSITY AND EDUCATIONAL NEWS

Official announcement is made in *Yale Alumni Weekly* of the construction in the immediate future of a new chemical laboratory by Yale University. It will be known as the Sterling Chemical Laboratory and will be constructed to accommodate all the undergraduate and graduate chemical activities of the university. At present the department of chemistry is occupying the two departmental laboratories, Kent and Sheffield, which are inadequate to meet the future growth of the department.

A memorial has been presented to the council of the Senate of the University of Cambridge for a syndicate to be appointed to consider possible alterations in the Mathematical and Natural Sciences Triposes with the object of facilitating the acquisition by candidates in one subject of a knowledge of the other.

Professor R. A. Dutcher of the department of biochemistry will leave the University of Minnesota at the end of the school year to become head of the department of chemistry in the college of agriculture at Pennsylvania State College.

Professor A. D. Ross, professor of mathematics and physics and formerly vice-chancellor of the University of Western Australia, Perth, has been elected a member of the governing body of the university.

It is proposed to appoint Professor H. Lamb, now in residence in the University of Cambridge, to an honorary university lectureship to be called the Rayleigh lectureship in mathematics.

DISCUSSION AND CORRESPONDENCE

THE AURORA OF MAY 14, 1921

A very bright auroral display was observed here on the evening of May 14. The sky was overcast until 10 p.m. eastern standard time. As the clouds dissolved, the aurora was noted in spite of the bright moonlight.

The focus of the display was near the zenith in the vicinity of the star Arcturus. From that point streamers radiated in all directions,

constantly changing both in position and in intensity. Across these streamers, pale green pulsating clouds drifted, in general from north to south, but occasionally assuming a spiral form around the zenith. They attained their maximum brightness near the zenith where they were especially conspicuous on account of their almost instantaneous changes in intensity.

Bright colors were not noticed during the evening, but after the moon set about midnight, pale reds and blues appeared on the edges of the streamers and clouds. The display continued at intervals throughout the night. It was not more conspicuous in the north than in other directions.

The aurora was undoubtedly due to the very large group of sun-spots which had just passed the center of the sun's disk.

Frederick Slocum

Middletown, Conn.,
May 15, 1921

Against a clear, moonlit sky, a brilliant auroral display was observed at Ames, Iowa, between 8:30 and 10:30 p.m. on May 14. The arch which was visible throughout this time except at short intervals, formed in our magnetic north and extended about 15 degrees above the horizon.

As the streamers, which were predominantly white, grew in number, in length and in extent along the horizon, they converged to a focus at a point somewhat variable in position but approximately 15° south and 5° west of the zenith, which point, the magnet zenith, became a center of radiation for the streamers. Abouth 15 minutes before the maximum development of the display, streamers of red were seen to rise from the horizon a few degreees south of east and to extend through the radiant center to the horizon about the same distance north of west, forming an arch along a magnetic parallel.

The maximum degree of brilliancy was attained at 9:27, when the streamers from a large coronal area formed about the magnetic zenith extended to the horizon in all directions, lighting the entire heavens. The radial streamers were visible within a few degrees of the moon, which had just passed the first quarter. At this time a dark area a few degrees west of south on the horizon closely resembled an auroral arch, but a definite segment of a circle like that on the northern horizon could not be discerned.

The shades, tints and hues, changeable and increasing from the beginning of the observation, now became more distinct and all of the primary colors appeared in varying degrees of intensity. Reappearing intermittently, the colors gradually faded away during the remaining hour of the display.

John E. Smith

Department of Geology,
Iowa State College

RUSSIAN GEOLOGISTS

The sad fate that has befallen many of the leading Russian geologists and mineralogists constitutes a gloomy chapter in the history of these sciences. From particulars gathered by Professor Sederholm, of Sweden,[1] and confirmed by a personal letter of March 30, 1921, received from Dr. Cornelius Doelter of Vienna, the following data have been secured.

Of some seventy Russian specialists in these fields eleven are dead. Of these, there died in Petrograd the well-known Professors Inostranzer, Fedorov (who died of hunger), Karakash, Derzhavin and Kasanski. Professor Sokolov died in Moscow. Professor Armasevski was shot in Kiev, as were Professors Samiatin and Mitkyevich in Petrograd. Stopnjevich died of smallpox and Snertkov of hunger-typhus. Baron Rebinder committed suicide, and it is reported that Faas is seriously ill.

The president of the Petrograd Academy of Sciences, and former director of the Geological Institute, Alexander Karpinsky, the Nestor of Russian geologists, who is now eighty years old, lives with his three daughters, a son-in-law, and his grandchildren, in a cold kitchen, and suffers great deprivation be-

1 Given by Professor Mohr in *Centralblatt für Mineralogie, Geologie und Paläontologie*, 15 Jan., 1921, No. 2, p. 60, from the *Svenska Dagbladet.*

cause of the lack of necessaries of life, although his scholars, with touching zeal, bring everything they are able to secure.

Professor Andrussov and the Academician Vernadsky were fortunate enough to make their way to South Russia, and it is stated that the latter seems to be in good circumstances, as he has founded a new academy of sciences in Kiev, and also a new university in Simferopol. About ten of these scientists fled across the frontier, and escaped to Finland or Poland, or even to America or Japan, and perhaps as many more are scattered through Siberia. From fifteen to twenty are probably in the Russian provinces, but only about ten are managing to exist in Petrograd.

The famous mineralogist Fedorov, whose death from hunger we have noted, was the first to proclaim, at a meeting in St. Petersburg, in 1889, the great advantages that would result from the application of the principle of the theodolite to goniometrical researches. Four years later, in 1893, he published his classic work, "The theodolite method in mineralogy and petrography." [2]

G. F. K. and E. T. W.

[2] W. W. Nikitin, "La Méthode universelle de Fedorov," French transl. by Louis Duparc and Véra de Dervies, 2 vols. Geneva, Paris and Liège, 1914, Vol. I., p. 6.

SCIENTIFIC BOOKS

The Coccidæ. Tables for the Identification of the Sub-families and Some of the More Important Genera and Species, together with Discussions of their Anatomy and Life History. By Alex. D. MacGillivray. Scarab Company, Urbana, Ill., 1921. Pp. viii + 502. $6.00.

Entomologists who have been acquainted with Dr. MacGillivray's thoroughgoing studies of the scale-insects have long awaited the appearance of this volume. The material was originally collected for the use of students in the identification of Coccids. Prepared in its first draft about fifteen years ago, it has been greatly extended, modified and revised as it was being tested out in laboratory and class work.

In no group of insects of equal importance is so much reliance in systematic work placed upon minute structural details. Many a would-be student of the group has been deterred by difficulties of preparation of material and by lack of a comprehensive discussion, in English, of the morphology. To such the volume will prove a veritable boon.

A chapter is devoted to details of technique. In this are considered necessary equipment, tools, clarifying and the various stages in the making of permanent preparations. This is followed by a chapter on the external anatomy of the Coccidæ. The "great number of species and the dearth of usable characters, because of the simplification of their external form and structure, makes it necessary to employ every available structure." In spite of the lack of illustrations, the discussion and definition of these structures is clear-cut.

Figures were omitted for pedagogical reasons.

> The tables were prepared primarily for the use of students. Those who have had any experience in teaching know that most students will not undertake anything they are not forced to do. The omission of figures makes it necessary for them to study their specimens rather than figures.

The autnor's detailed studies on the phylogeny of the different subfamilies, genera and species have led him to the establishment of a considerable number of new genera, which are here defined for the first time. The group as a whole he divides into seventeen subfamilies, which have been treated in an ascending order. A tabular arrangement indicates what the author believes to be the relation of these subfamilies, and the scientific and vernacular names that have been applied to them.

Dr. MacGillivray has done a real service in making the materials of his course available to a wider audience. The book will prove indispensable to future students of the Coccidæ.

Wm. A. Riley

The Soils and Agriculture of the Southern States. By Hugh Hammond Bennett, of

the Bureau of Soils, United States Department of Agriculture. The Macmillan Company, New York. 1920. Pp. xviii + 399. Illustrations: 56 plates, general soil map of the Southern States (frontispiece), and four additional maps.

This book departs from the usual trend of books on soils in that instead of dealing with the properties and nature of soils in general the author describes the origin, geographic distribution, physical characteristics, agricultural adaptations and management of all the important soils occuring in the area under discussion. The states included in the work are those lying south of the north boundaries of Delaware, Maryland and West Virginia, south of the Ohio River, and south and east of and including Missouri, Kansas and Texas.

In the introduction the author explains the division of the country under consideration into soil provinces and subordinate soil regions, and describes the United States Bureau of Soils system of classification and nomenclature of soil series and types. The introduction further takes up the geographical distribution and in general the adaptation to different soils of the various crops grown in the South; and the influence of climate on soils and crops.

The general geography, topography, geology and agriculture of each soil province and its subordinate soil regions are discussed, followed by detailed descriptions of the individual soils. These descriptions include the location, physical and frequently chemical characteristics, topography, drainage and crop adaptation of each soil, and methods of soil management and fertilization which actual farm practise and experimentation have proven to be most effective.

Four appendixes include discussions of the meanings of terms used in soil classification, chemical analyses of representative southern soils, a bibliography of important publications on soils and related subjects, and statistics bearing on some of the important farm products of the southern states.

The book is valuable not only to students and agricultural investigators but also to farmers and especially to those contemplating settling in the south.

Wm. B. Cobb

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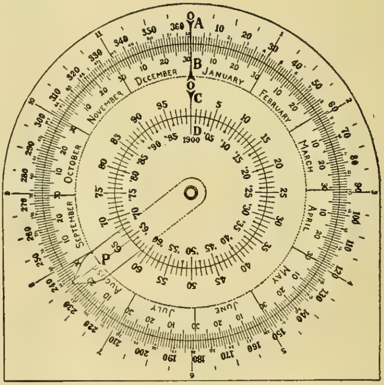
Louisiana State University

SPECIAL ARTICLES

AN AGE-COMPUTING DEVICE

1. In a recent issue of Science (1920, No. 1336, pp. 134–135), Dr. Slonaker describes a device for the simultaneous determination of the ages of two individuals at different times in their lives, involving the use of a calendar in which the days are numbered consecutively throughout the year. The present device obviates the need of the calendar and the need for resetting for dates in different years. As used with reference to human beings, two accessory scales aid in determining in years the age of an individual at different episodes in his life, when his present age and the years in which the episodes occurred are known, and vice versa.



Age-Computing Circular Slide Rule

2. A small disk 2 inches in diameter, a larger disk 3½ inches in diameter, and a 4½-inch square are cut from a sheet of opaque white celluloid and, with thin washers intervening, are pivoted at their centers on an eyelet. The square is cut further to present a semi-circular border from one end of the transverse diameter to the other. An adjust-

able pointer (P), bearing a median hair line throughout its length, is placed between the two disks and consists of a strip of transparent celluloid pivoted at one end on the eyelet and extending with a sharply pointed tip to the periphery of the larger disk.

3. Scale A, marked on the acircular sheet exetrnal to the circumference of the larger disk, is comprised of 365 equidistant radial lines numbered by tens from 0 (index a) to 360, representing successive days. Every seventh line if accented by a dot and numbered serially from 0 (index a) to 52, indicating weeks. An outer scale divides the circumference into twelve equal parts, each in turn divided into fourths, and is numbered from 0 to 11 to indicate months.

4. A coinciding scale (B) extends along the circumference of the larger disk but is graduated by months, the last line of each being prolonged centrally and the intervening spaces labelled with the names of the corresponding months. The index (b) of this scale is an accentuated line representing December 31.

5. An inner scale (C) on the same disk lies around the circumference of the smaller disk and, with 0 (index c) on the same radius as index b, divides the circumference into 100 equal parts. The lines are numbered by fives from 0 to 95 and represent successive years.

6. Individual years are represented by scale D on the smaller disk. This scale coincides with scale C and is numbered from '05 to 1900 (equivalent to any even hundred year). Attention is called to leap years by a dot on every fourth line from that of '04 to that of '98, inclusive. An erasable mark accentuates the present year.

ILLUSTRATIONS OF THE USE OF THE CIRCULAR SLIDE RULE

(a) To determine the interval between two dates less than 365 days apart. (The order in which the steps are taken is indicated by the numbers in the schematic diagrams.)

Scale A.		(3) At P, read the number of days (weeks or months).
Scale B.	(1) Set P at later date.	(2) At index a, set earlier date.

Example: Find the interval between May 21 and November 3.

Scale A.		(3) At P, read 166 days (23 weeks, 5 days, or 5 mos., 14 days).[1]
Scale B.	(1) Set P at November 3.	(2) At index a, set May 21.

In a leap year, if February 29 falls within the interval determined, 1 is to be added to the number of days indicated at P. This result is best obtained by advancing P one day in step (1), as follows:

Example: For the interval from July 5, 1919, to March 13, 1920.

Scale A.		(3) At P, read 252 days (or 8 mos., 9 days).
Scale B.	(1) Set P at March 14 (March 13 + 1).	(2) At index a, set July 5.

(b) To find the age on September 17, 1920, of an individual born March 23, 1867 (if the entire process were to be carried out):

[1] Although the reading in total days is invariably accurate (not considering leap year), readings in months and days may deviate from the customary calculation by not more than 3 days (because of the inequality of the calendar months). After the number of whole months is read, the number of days in the remainder may be determined accurately by rotating scale B, carrying P (already set at the later date) in the clockwise direction past index a until the first day represented by the same figure as the earlier date is at index a. Then, at P on scale A, read the number of days in the remainder. Thus, in the same example (from May 21 to November 3):

Scale A.		(3) At P, read 5 months.	(5) At P, read 13 days.
Scale B.	(1) Set P at November 3.	(2) At index a, set May 21.	(4) At index a, set October 21.

Scale *A*.			(6) At *P*, read 5 mos. 26 days.	(8) At *P*, read 25 days.
Scale *B*.	(2) Set *P* at Sept. 17	(3) At index *a* set Mar. 23.		(7) At index *a* set Aug. 23.
Scale *C*.			(5) Read 53 years.	
Scale *D*.	(1) Set '67 at index *c*.		(4) Opposite '20.	

In this example, since the earlier date (March 23) precedes the later date (September 17) within the same calendar year, *P* in step (6) lies within the sector extending clockwise from index *a* to index *b*. If the *later* date precedes the *earlier* date on scale *B*, *P* lies outside the sector similarly formed, and 1 must be subtracted from the number of years indicated in step (5). Thus, in the following example—an unusual case involving all the steps heretofore described—

Example: What is the age on March 3, 1920, of an individual born July 16, 1873?

Scale *A*.			(6) At *P*, read 7 mos. 19 days.	(8) At *P*, read 16 days.
Scale *B*.	(2) Set *P* at Mar. 4.	(3) At index *a* set July 16.		(7) At index *a* set Feb. 16.
Scale *C*.			(5) Read 47–1, or 46 years.	
Scale *D*.	(1) Set '73 at index *c*.		(4) Opposite '20.	

In step (3) it is seen that *P* lies outside the sector extending clockwise from index *a* to index *b* and accordingly 1 is subtracted from the reading in step (5). In step (2), correction is made for the occurrence of February 29 in the interval, and by steps (7) and (8) is obtained the correct reading of days in the remainder of the reading in months (step 6). The age, then, is found to be 46 years, 7 months, 16 days.

(*c*) To determine the period of liability in industrial insurance:

A new index (a') may be marked on scale *A* at a point representing, in the counter-clockwise direction from index *a*, the number of days in the legal interval between the date of injury and the first day of compensation. For example, in Massachusetts, where compensation starts on the 15th day of incapacity, index a' is marked at 351. With the day of injury (scale *B*) set at index a', the number of days of compensation may be read directly on scale *A* at the day on scale *B* representing the date of termination of disability.

Example: For what number of days shall compensation be paid to an employee injured on April 9 and incapacitated until August 5?

Scale *A*.		(3) At *P*, read 104 days (or 14 weeks, 6 days).
Scale *B*.	(1) Set *P* at Aug. 5.	(2) At index a' (351), set April 9.

(*d*) To find the decimal fraction of a year equivalent to a given number of days.

Example: What per cent. of a year is an interval of 211 days?

Scale *A*.		(2) Set *P* at 211.
Scale *B*.	(1) Set index *b* at index *a*.	
Scale *C*.		(3) At *P*, read 58 per cent.

Or, to find the number of days equivalent to a decimal fraction of a year:

Example: What is the equivalent in days of .36 year?

Scale *A*.		(3) At *P*, read 131 days.
Scale *B*.	(1) Set index *b* at index *a*.	
Scale *C*.		(2) Set *P* at 36.

7. The device may, of course, be made in any desired size but the dimensions given seem the most convenient, and the acircular shape of the base facilitates locating index *a*. Indelibility is obtained by engraving the lines with a steel point and filling with India ink.

8. Illustrations of the use of this compound circular slide rule are given above.

C. M. Kelley

Psychological Laboratory of
McLean Hospital

MEETING OF COMMITTEES ON CONSERVATION

Committees on Conservation appointed by the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science met jointly in the American Museum of Natural History, New York City, April 9, to consider the present status of the conservation movement from the point of view of science, means for increasing the coordination of the numerous agencies interested in the various aspects of conservation, and particularly the far-reaching relation of the principles of the conservation of natural resources to the economic and social welfare of the country. The members present at this meeting were: J. C. Merriam, chairman of three committees, Isaiah Bowman, J. McK. Cattell, John M. Clarke, Henry S. Graves, Vernon Kellogg, C. E. McClung, and Barrington Moore, and by invitation Willard G. Van Name.

The point of view of the committees and the major considerations discussed at this meeting are stated in an address which Mr. Graves presented at this meeting and which is published in full elsewhere in this issue of Science.

It was the unanimous opinion of the members of the committees that an organization should be effected representing the scientific men of the country, and that the functions of this organization, broadly speaking, should be as follows:

1. To bring scientific research to bear more effectively upon the problems of conservation. This involves the extension among research men of a knowledge of the scope, the objectives, and the economic problems of conservation, and the assurance that in the studies of each resource there is an appreciation of its relation to other resources, and the correlation of the programs of research in each field of work.

2. To assemble the available data relating to our natural resources, and the interpretation of these data from the standpoint of conservation and of the relation of the problems of the various resources, severally and taken together, to the economic, industrial, and social welfare of different regions and of the nation as a whole. This work is essential for an adequate definition of our conservation problems, and to furnish the economic background for the many proposals for public action by the states and by the federal government.

3. To bring about the introduction in our educational institutions of instruction in the principles underlying conservation. The plan of instruction should be subject to great variation in different institutions. The instruction might be given in connection with courses in economic or political and social science, or economic and industrial history, or in connection with various courses in engineering and applied science, or in special courses in conservation.

The undertaking would involve personal contact and cooperation with the institutions or educational organizations. It would involve further suggestions as to the preparation of text-books and special material for demonstration, such as charts, models and maps, and suggestions regarding the methods of instruction.

4. To effect leadership in a campaign of popular education as to the meaning of conservation, and the necessity for the adoption of its principles.

5. To bring into effective harmony the efforts of the different forces of the country concerned with conservation based upon scientific research which it is difficult for any of the existing agencies to effect.

The following resolution was adopted to be reported for approval to the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science:

Resolved: That it be recommended by the committees appointed by the American Association for the Advancement of Science, the National Academy of Sciences, and the National Research Council that they form a continuing joint committee on national conservation representing those organizations, and that this committee be authorized to set up an executive and secretarial agency for the active prosecution of its work.

To carry forward the purposes of this resolution the following motions were passed:

Moved: That a Project Committee of three members be appointed by the chairman to draw up a plan of action to be presented to a Ways and Means Committee for execution.

Moved: That a Ways and Means Committee be appointed by the chairman to consist of one representative each from the National Academy of Sciences, National Research Council, and American Association for the Advancement of Science; and, conditioned upon the approval of the resolution just adopted, by these three organizations, to undertake (1) to secure means for meeting the comparatively small expenses of these three initial committees, and (2) to secure larger funds for the permanent support of a conservation movement as outlined in this discussion.

The resolution adopted by these committees has been approved by the Council of the National Academy of Sciences, the Executive Board of the National Research Council, and the Council of the American Association for the Advancement of Science at the recent meetings of those bodies and funds have been provided for defraying the immediate expenses of these committees.

Albert L. Barrows,
Secretary, pro tempore

THE WESTERN SOCIETY OF NATURALISTS—SAN JACINTO SECTION

The San Jacinto Section of the Western Society of Naturalists held its spring meeting in San Diego and La Jolla, California, on Friday and Saturday, April 1 and 2, 1921. The Friday session convened at 2:30 at the San Diego Museum of Natural History in Balboa Park, President H. S. Reed, of Riverside, presiding. The following papers were presented at this session:

Bryan, W. A. (Museum of History, Science, and Art, Los Angeles): "Observations on the fauna and flora of some seldom visited Pacific islands."

Sumner, F. B. (Scripps Institution for Scientific Research, La Jolla): "Responsibility of the biologist in the matter of preserving natural conditions."

Taylor, W. P. (Bureau of Biological Survey, Dept. of Agriculture): "Distribution of mammals and birds on Mount Ranier."

Frost, H. B. (Citrus Experiment Station, Riverside): "International language in relation to science."

Conklin, E. G. (Princeton University): "The chromosome theory of heredity applied to ontogeny and phylogeny."

Carsner, Eubanks (Bureau of Plant Industry, U. S. Dept. Agr.): "A serious disease of the sugarbeet in California."

The society adjourned at 6:00 o'clock to the San Diego Hotel for the annual dinner and a short business meeting at which Dr. F. B. Sumner, of the Scripps Institution, La Jolla, was elected president for the coming year, and Dr. F. J. Smiley, of Occidental College, Los Angeles, reelected secretary. After the business meeting the following papers were presented:

Essenberg, Christine (Scripps Institution): "An interesting group belonging to the marine fauna of San Diego Bay."

Allen, W. E. (Scripps Institution): "Investigation of the ocean pasturage."

Halma, F. E. (Citrus Experiment Station): "Regeneration of the roots of sour orange."

Barnhart, P. S. (Scripps Institution): "Observations on the habits of the trap-door spider."

Saturday morning the section assembled in La Jolla and visited Torrey Pines Park, a reservation for the protection of one of California's rarest trees (*Pinus Torreyana* Parry). The afternoon was devoted to an inspection of the Scripps Collection of Watercolors illustrating the flora of California at the home of Miss Ellen Scripps, and to visiting the Scripps Institution.

The next meeting is to be held at the call of the president and secretary.

F. J. Smiley,
Secretary

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INAUGURAL ADDRESS[1]

The institute, like every other educational enterprise, has its individual problems and needs, but these I do not yet sufficiently understand to make a public discussion of them profitable to anybody. What I shall say, therefore, bears on technical education in general without reference to the separate needs of this or any other school.

I

Many of you who have lately become familiar with Mr. H. G. Wells's interpretation of history will realize new significance in the fact that children are born into a world that is already old. For many thousand years before our generation men were experimenting with Nature, with social, economic, political, and religious ideas and practices. Our civilization to-day is the forward-borne product of this slowly and painfully acquired experience of the race.

The whole educational process, broadly seen, is the problem of putting our young people in touch with the more outstanding results of this age-old accumulation and of giving them exercise in the most direct thought processes by which this experience and knowledge have been acquired; processes by which experience and knowledge may be enlarged and extended.

The education of boy or girl, therefore, consists in bringing them up to the present day, so that they can enter independent life as useful thinkers and doers in the world as it is. Dreams of what the world ought to be are not only stimulating but indispensable to human progress, but each generation must begin building on the world as it finds it.

Expressed otherwise, our educational effort

[1] Given by Dr. Ernest Fox Nichols on the occasion of his installation as president of the Massachusetts Institute of Technology.

is directed to give a young man of intellectual interests and possibilities the main features of his racial background and especially to acquaint him with the best and most significant things which have been thought and done in the world, so that at maturity all new things which present themselves to him, he can in some measure appraise in their relations to this background.

I know no better measure of a man's real education than the adequacy of his thought and action in whatever actual situations he may find himself, for adequacy of thought and action imply some hold on world experience. Our daily use of the phrase "common sense" has no other meaning.

Vital possession, conscious or unconscious, of this world background enables a man sanely to face and interpret reality. You rarely find such a man seriously occupied in chasing rainbows or fighting windmills. His chief mental characteristics ars breadth, balance, sanity. To train such men and women should be the dominant ideal of the educational process. How often and how far, alas! do we fall short of attaining it.

Mr. Chesterton's recent amusing raillery at "The ignorance of the educated" would lose none of its charming humor and would gain in truth and pungency if he changed his title to "The ignorance of the half educated." These are the really dangerous men, for they are facile of speech and wholly unaware of their intellectual limitations. By contrast the adequately educated man knows always just where he stands. Ought not an engineer to know enough of philosophy and its uses not to be misled into dogmatizing upon its technical intricacies: and should not a philosopher be taught enough about bridges and dynamos to be satisfied with dwelling on the broad scientific principles they illustrate without venturing to criticize minor details of construction?

Education interpreted as a background builder is far wider than the schools and stretches endlessly from the cradle to the grave. Yet a careful scrutiny of the course of individual development shows that in the latter half of the period of adolescence, say from eighteen to twenty-five years of age, lie the strategic years of education. It is in this period that wisely directed teaching can do most to integrate and interpret this background, do most to give it unity of form and grouping, color, symmetry, and depth. During this formative period no great department of human experience can be safely ignored, if our purpose is to train adequately educated men and women.

The department of human experience and action on which the major emphasis shall fall is a matter wisely left to the individual preference, aptitude, and taste of the student. In schools of technology this emphasis falls naturally on the study of science. But studies in science can be made as narrow as can studies in philosophy and the arts. Narrowness of outlook, always a major defect in our efforts at education, we must strive unceasingly to avoid. All fields of knowledge and experience form a whole, and, in our teaching, their vital interdependence must be most clearly emphasized.

With his characteristic grasp of essentials, President Nicholas Murray Butler has stated these traits of the educated man: (1) Correctness and precision in the use of English; (2) refined and gentle manners; (3) power of reflection; (4) power of growth; (5) sound standards of feeling and appreciation; (6) the ability to do efficiently without nervous agitation. To these I venture to add yet another trait of the *usefully* educated man: Power to marshal the world's experience in at least one field, and to use it effectively for further constructive achievement.

Engineers have, surely, the same broad, educational rights and responsibilities as other professional and non-professional men, yet, amid the growing complexities and perplexities of technical education there has been, and is, a steady and strong temptation to introduce more detailed technical courses at the expense of other background building studies. This temptation, weighty as are the arguments for yielding to it, must nevertheless be steadily and firmly resisted. The problem of modern technical education is indeed most intricate and difficult, but other solutions must be

earnestly sought, for we can not afford to sacrifice the breadth of a man to create a too narrowly efficient machine.

II

When President Maclaurin said "A technical school was not doing its whole duty unless it kept in the closest touch with industry," he spoke the minds of many thoughtful men.

The two outstanding industrial problems to-day are: (1) The more intensive application of scientific knowledge and research to the processes and products of industry; (2) the cultivation of more understanding and wholesome relations between labor and management. Both of these problems may rightly claim attention in any modern scheme of technical education. On each of these questions I wish to speak very briefly.

Of scientific research there are two more or less distinct types. Both embody the genuine spirit of inquiry; both use the same tools and instruments under similar laboratory conditions. The essential difference between them is not in method but in aim and intention. In applied science research, the controlling purpose is to reach a definite and predetermined result which can be immediately applied to the material profit, convenience, or comfort of man. In pure science research, the only purpose is the discovery of new knowledge without thought of any material benefit to anybody. The fundamental discoveries from which applied science gets its raw material for useful applications come out of the pure science laboratory. That you can not apply knowledge you haven't got needs no proving.

Take any familiar application of science you choose, and one, two, or at most three backward steps bring you to the pure science laboratory where the fact or principle employed was first discovered. Sir J. J. Thomson has said in substance, "If you want improvements in industry, you may turn with confidence to applied science. If you want to revolutionize an industry or create a new one, you will do well to search the innermost recesses of the pure science laboratory." The difference between the man of theory and the practical man is one of suggestiveness and scope.

Applied science research in the modern sense is of comparatively recent origin. What we now call pure science is centuries older. At its beginning, therefore, applied science had the accumulated results of centuries of pure science to draw upon, but, due to the brilliantly amazing progress of applied science, that surplus in many fields is nearing exhaustion.

With depleted reserves applied science must soon face one of two alternatives. Either it must descend from its past and present rapid succession of great achievements to a more modest hand-to-mouth existence, reworking old ones and consuming next year whatever pure science, at its present working rate, may discover this; or else the hosts of pure science research must be vastly strengthened, and the volume of their yearly output many times increased.

That some of our more progressive industries already realize the situation is amply proved by the very rapidly increasing amount of pure science research issuing from the research laboratories of our optical, chemical, electrical, and other highly developed industries.

Under these circumstances technical schools owe to modern industry the more intensive cultivation of research with increasing emphasis on pure science. Every possible means should be used to train up more men in pure science, men competent to enter the fruitful and important field of research, to supply the rapidly increasing demand for workers in the fast multiplying laboratories of progressive industry.

In every fruitful cooperation between technical education and industry, our schools should be prepared to give more than they receive and to lead, not follow.

III

Under the present organization of our largest industries the conscious responsibilities of real ownership have become somewhat vague. Industrial ownership to-day is widely diffused

and dispersed. Shares of ownership are bought and sold daily by hundreds of thousands. Certificates of ownership are often regarded by their holders more as sources of income than as symbols of responsibility.

As a working plan the rights and duties of ownership are delegated to boards of directors, and the active management of our industries rests in the hands of employees. Thus the older distinction of employer, meaning owner, and employee, meaning workman, has largely ceased in our largest industrial corporations. All are essentially employees but of two distinct classes, brain workers and hand workers. The brain workers build up, maintain, and manage the business, and direct the hand workers, as brain directs hands in the individual, with this important and sometimes vaguely realized difference, that the hands in this case are not instruments only but independent thinking, feeling personalities.

The older or traditional attitude toward labor unrest was that the questions involved were purely economic questions. More thoughtful and more widely informed people, and there are many of them, feel that the problem is not so simple, but involves many additional elements, chiefly those which enter into all human relationships.

Purely for the sake of illustration, let us take the case of a not uncommon type of workman who becomes dissatisfied with his job. He feels little or no loyalty to the business nor to the foreman or manager who personifies it. He understands neither the manager's work in relation to production, nor the manager's pay.

There are further enviable differences between the manager's apparent freedom of action, his more comfortable working surroundings and those of the laborer. The laborer fails to realize the economic reasons for these differences. The manager in his sight produces nothing, hence the laborer doubts in his heart the importance of managers and higher officials in general. From his warped outlook, wages would be higher if these men who meddle, but do no real work, were removed from the payroll.

Thus he feels little respect or liking for the management. The manager may also seem lacking in respect for a sour-tempered operative. The motives behind the simplest manifestations of good will may be misconstrued and distrusted. Thus a mutual economic necessity is the only binding material which holds these two together, and each chafes at the bond.

Dissatisfied, the laborer shirks and hates his employment which, in this mood, is without human appeal or interest for him. Furtively shirking, he loses some of his sense of personal dignity and much of his self-respect. Sooner or later, as circumstances favor, he will try to regain a feeling of self-importance by trying with others who are like-minded a concerted conflict with the management in the form of a strike.

If the strike is won, the worker feels his course justified, his conduct approved, his self-esteem in a measure restored. If lost, he returns to his work liking it and his superiors none the better, only to wait sullenly for another trial of strength.

The laborer's indiscriminate and integrated discontent he is likely to attribute to the specter called capitalism. Capitalism is, therefore, his enemy. This monster he attacks in the one spot where he believes its nervous system is centered—its purse. To the agitator of disorganization this mass of accumulated and unsorted discontent is his one great opportunity, and we know he is quick to make the most of it. To the typical proletarian, not the least of the attractions of a world-leveling-down program is the removal of the people he believes respect neither him nor his labor.

This brief view of the tangle of disorders and misconceptions, which may arise in a workingman's mind, shows mental states of by no means infrequent occurrence.

Now the true essence of successful industry is mutual respect between employee and manager, willing cooperation, a sense of mutual opportunity and responsibility, and a shared personal or institutional loyalty. But these factors are human rather than economic. Economic necessity alone is not only powerless to

create them but oftener operates to weaken or destroy them.

Human relationships in industry we have now and always have had, and, whether recognized or not, they have caused quite as much trouble as purely economic conditions, for the state of a laborer's mind, more even than the state of his purse, determines his acts.

No industrial question is of greater importance than human relations in industry, and none is more complex nor baffling. Yet no pains can be spared, or are being spared, to find remedial measures. Many hopeful schemes for a better human organization of industry have been suggested and are under trial, some fortunately with encouraging promise.

The dominant bearing of this discussion on technical education is this: Our technical schools are training the future brain workers and managers of industry. We may, therefore, well ask ourselves, at this time, if there is anything we can do beyond what we are now doing to train our students to understand more fundamentally and to meet more successfully the gravest of all their future repsonsibilities, the organization and management of men. A responsibility which they and we owe, not industry alone, but the whole economic, social, and political stability of the nation.

Ernest Fox Nichols

SCIENCE AND COMMUNITY TRUSTS

The Research Information Service of the National Research Council recently compiled available information about funds for scientific research. It appears that there are hundreds of special funds, trusts or foundations for the encouragement or support of research in the mathematical, physical, and biological sciences, and their applications in engineering, medicine, agriculture and other useful arts. The chief uses of these moneys are prizes, medals, research scholarships or fellowships, grants, sustaining appropriations, and endowments.

So numerous have been the requests to the Research Council for information about sources of research funds, availability of support for specific projects, and mode of administration of particular trusts or foundations that the Research Information Service has created a special file for this information which it is proposed to keep up to date for the benefit of those who may desire to use it. Furthermore, in order to give wider publicity to the immediately available information, the Council has issued a bulletin under the title, "Funds available in 1920 in the United States of America for the encouragement of scientific research." This publication has been distributed widely to American scientists and to those who are interested in furthering the development of science.[1]

In the course of search for data on research funds, it was discovered that some of the recently created community foundations or trusts control funds which may be used, at the discretion of their distributing boards, for scientific surveys or for research. If the resources of community foundations be added to the funds at present listed by the Research Information Service as primarily for research in the natural sciences, the total approximates five hundred million dollars. It is estimated that for the encouragement and support of scientific research through medals, prizes, grants and research scholarships and fellowships, between forty and fifty million dollars is spent in the United States annually.

The "community trust" idea is of peculiar interest and significance in this connection. In the year 1914 certain wise and far-sighted citizens of Cleveland decided to organize for the benefit of the community a trust to be known as the Cleveland Foundation. This, the original community trust, has grown to a fund of approximately one hundred million dollars, either given or bequeathed. Following the lead of Cleveland, more than forty other American cities have organized similar trusts, primarily to assure greater security of principal, flexibility in the use of income, and prevention of obsolescence.

[1] Inquiries concerning research funds should be addressed to the National Research Council, Information Service, 1701 Massachusetts Avenue, Washington, D. C.

The seriousness of the risk of obsolescence and the enormous economic waste which results therefrom are effectively presented by Mr. Frank J. Parsons, Director of the New York Community Trust:

Judge F. H. Goff, originator of the community trust plan, is authority for the statement that in England alone there are some 40,000 foundations or trusts with fixed objects. The great majority of these bequests have become obsolescent by reason of social or economic changes. The situation finally became so serious in England that Parliament passed an Act, the intent of which was to revive the trusts and renew their usefulness.

The United States, although young, is by no means free from illustrations of the folly of making charitable gifts with fixed objects. Benjamin Franklin, one of the wisest of Americans, set aside a certain sum of money in his will, to be used only for the maintenance and benefit of a certain type of artisan, numerous at the time, but non-existent to-day because of changes in social conditions and the introduction of machinery. Wise in his own generation, Franklin failed when he tried to provide for the indefinite future.

Prior to 1850 Bryan Mullanphy, a wealthy lawyer and at one time mayor of St. Louis, personally helped hundreds of travelers who became stranded in his city on their way to the great undeveloped West. When he died it was found that he had left one third of all his property to the City of St. Louis, as trustee, to "aid and assist worthy and distressed travelers and emigrants coming to the City of St. Louis *bona fide* to settle for a home in the West." His act was greatly commended and all thought he had wisely applied his charity to meet a great need; yet fifteen years later the railroads had pushed into the West far beyond St. Louis, and the number of needy travelers coming within the terms of the bounty of Mullanphy's will was greatly diminished and is now practically nil. The estate now amounts to $975,000, and the three Commissioners having the management of the city's trust are still bound by the original terms of the will as laid down in 1851.

In 1907 Robert N. Carson, of Philadelphia, left $3,500,000 for the care and education of "poor white healthy girls, both of whose parents shall be deceased," and in 1909 Charles E. Ellis, also of Philadelphia, left $4,500,000 for "full orphan or fatherless girls." The hampering and restrictive conditions of the wills in each case were such, however, that after the lapse of more than ten years the trustees of these two great gifts are caring for but 114 girls, while the funds are said to be sufficient to provide for from 600 to 1,000 girls.[2]

The following "illustrative purposes" are quoted from the Resolution and Declaration of Trust creating the New York Community Trust:

(*a*) For assisting public educational, charitable or benevolent institutions, whether supported wholly or in part by private donations or by public taxation;

(*b*) For promoting scientific research for the advancement of human knowledge and the alleviation of human suffering or the suffering of animals;

(*c*) For the care of the sick, aged and helpless;

(*d*) For the care of needy men, women and children;

(*e*) For aiding in the reformation of (1) victims of narcotics, drugs and intoxicating liquors, (2) released inmates of penal and reformatory institutions, and (3) wayward or delinquent persons;

(*f*) For the improvement of living and working conditions;

(*g*) For providing facilities for public recreation;

(*h*) For the encouragement of social and domestic hygiene;

(*i*) For the encouragement of sanitation and measures for the prevention of disease;

(*j*) For investigating or promoting the investigation of or research into the causes of ignorance, poverty and vice, preventing the operation of such causes, and remedying or ameliorating the conditions resulting therefrom.

Science as well as charity has its "dead hand" trusts. It is wholly impossible for anyone to predict future conditions or needs. Consequently the community trust idea should interest all who desire to promote the public welfare with minimum risk of having their gifts pass into desuetude. Many of the existing foundations and corporations which bear the names of individuals are in principle

[2] These statements are in part quoted from Mr. Parsons and in part paraphrased for the sake of brevity.

community trusts, but they have the temporary disadvantage of intimate association with the personality or memory of a particular family or individual. They therefore are somewhat less likely to receive during their early history such gifts as readily come to the community trust which bears the name of a city or state.

Robert M. Yerkes
National Research Council

SCIENTIFIC EVENTS

THE MEDICAL SCHOOL OF COLUMBIA UNIVERSITY AND THE PRESBYTERIAN HOSPITAL

It has been announced from Columbia University that a permanent alliance has been effected between the university and the Presbyterian Hospital, to provide a medical center, and the large sums needed to carry the plan into effect, have been provided by gift.

Under the terms of the agreement, the university and the hospital each continue their independent existence and control. The medical school, now occupying the site bounded by 59th and 60th Streets and Tenth Avenue, and the hospital, now occupying the site between Madison and Park Avenues, 69th and 70th Streets, are as soon as possible to be provided with new and thoroughly equipped buildings upon a common site. The professional staff of the hospital is to consist of professors and other members of the faculty of the medical school, to be appointed by the hospital upon the nomination of the university. For the oversight of the common interests of the university and the hospital in the new undertaking, an administrative board is established, to consist of three representatives of the trustees of the university and three representatives of the managers of the hospital. The first administrative board is to consist of Messrs. John G. Milburn, Walter B. James, and William Barclay Parsons, representing the university, and Edward S. Harkness, Henry W. deForest and William Sloane, representing the hospital.

The large sums needed to enable Columbia University to bear its share in this enterprise, have been provided in the following manner:

$5,000,000 for endowment from the estate of the late Joseph R. DeLamar.

$3,000,000 for the construction of new buildings and their equipment, from the Carnegie Corporation, the General Education Board and the Rockefeller Foundation, each of which has pledged $1,000,000.

Land located between 165th and 168th Streets, Broadway and Fort Washington Avenue and valued at not less than $1,000,000, which is the gift of a donor who wishes to remain anonymous.

An additional sum of $1,000,000 for endowment from another anonymous donor.

GIFTS BY CARNEGIE CORPORATION TO CARNEGIE INSTITUTES OF PITTSBURGH

As a result of joint conferences held by the trustees, respectively, of the Carnegie Corporation of New York, the Carnegie Institute of Pittsburgh and the Carnegie Institute of Technology, a definite agreement has been entered into by the Carnegie Corporation to give an additional sum of more than $17,000,000 over a period of years for maintenance and development of the institutes.

According to a statement issued by the Carnegie Corporation, the Carnegie Institute of Technology now has about 4,000 students. They come from every state in the Union and from all parts of the world. The plan now to be carried out contemplates the full completion of Mr. Carnegie's gift in developing at Pittsburgh a great technical institute available for the young men, and particularly those in moderate circumstances, not only of the Pittsburgh district, but of the whole country. The plan is distinctly national in scope.

Under the arrangements now made, the institutions ultimately will have received from Mr. Carnegie, the corporation and other sources more than $49,000,000. The financial program that has just been mapped out may be summarized as follows:

OUTRIGHT APPROPRIATIONS

For the Carnegie Institute of Pittsburgh:	
Additional endowment	$2,000,000
Cash to be used at discretion of institute	672,888

For the Carnegie Institute of Technology:	
For expenses over a period of 25 years	5,640,000
For repairs and replacement of equipment	350,000
For a gymnasium, the planning of which is to begin at once	600,000
Total	$9,262,888

CONDITIONAL UPON ADDITIONAL SUMS BEING RAISED

For the Carnegie Institute of Pittsburgh:	
To accrue in 15 years on condition that an equal amount is raised for endowment of educational work of the Museum and Art Gallery	$ 200,000
For the Carnegie Institute of Technology:	
Maximum to be paid by July 1, 1946, on a basis of $2 for every $1 raised from other sources	8,000,000
Total	$8,200,000

SUMS TO BE RAISED FROM OUTSIDE SOURCES

For the Carnegie Institute of Pittsburgh:	$ 200,000
For the Carnegie Institute of Technology	4,000,000
Total	$4,200,000

From Mr. Carnegie during his lifetime and later from the Carnegie Corporation, the two Carnegie Institutes in Pittsburgh have already received $27,654,594.51, and the present program supplements those funds. Consummation of the financial arrangements now entered into will result as follows:

Previous appropriations made by Mr. Carnegie and the Carnegie Corporation	$27,654,594.51
Present outright appropriations	9,262,888.00
Present appropriations, conditional upon raising funds from other sources	8,200,000.00
Sums to be raised from other sources	4,200,000.00
Grand total	$49,317,482.51

MEETINGS OF BRTISH AND AMERICAN CHEMISTS

Joint meetings will be held this autumn by chemists of Great Britain, Canada and the United States. Members of the Society of Chemical Industry of Great Britain will join with the Canadian branch of their organization in sessions in Montreal late in August. The scientific and business sessions will center at McGill University, where there will be a special convocation. The Canadian and British chemists will inspect numerous plants and will proceed to Ottawa and Toronto, where they will be entertained by the local sections. On September 5 they will reach Niagara Falls, where they will view the vast establishments which modern physics and chemistry have created.

The members will then cross the border, being met by a committee of the American section of their society and conducted through the industrial plants on this side of the Falls. Dinner will be served at Buffalo, and on their arrival at Syracuse, they will have luncheon with the Solvay Process Company. The chemists will then go to Albany and New York City, where they will be welcomed by the American Section of the Society of Chemical Industry.

Elaborate arrangements for the reception of the chemists will be carried out, through the coordinating committee, of which Dr. B. C. Hesse is chairman and Dr. Allen Rogers is secretary. The festivities, meetings and entertainments which will follow are designed to bring into closer bonds all chemists of Anglo-Saxon stock.

The fall meeting of the American Chemical Society, with its 15,500 members, is to be held in New York City from September 6 to 10, inclusive. The first contact will be at a lawn party, to be given on the afternoon of September 7 to foreign guests and to scientific societies at Columbia University. Other societies asked to participate in the welcoming of the visitors from abroad are: The American Electrochemical Society; the American Institute of Chemical Engineers; the American Section of the Société de Chimie industrielle;

and the Manufacturing Chemists' Association of the United States. The foreign guests have also been invited to the smoker and entertainment of the American Chemical Society, which will be held on the evening of Wednesday, September 7.

Scientific sessions of the American Chemical Society, in which many matters concerning chemical research and applied chemistry will be discussed, are to be held at Columbia University. To these meetings the British and Canadian guests have been bidden. They will also be present at the banquet of the American Chemical Society on the evening of September 9 at the Waldorf-Astoria.

The fortnight beginning September 12 will be dedicated to American chemistry in all its phases, for it marks the holding of the National Exposition of Chemical Industries, which is to be held in the Coast Artillery Armory in the Bronx. There will be brought together under one roof a demonstration of what has been accomplished in this country since the European War in adapting the resources of the United States to national needs.

ORGANIZATION OF MEMBERS OF THE AMERICAN ASSOCIATION AT THE PENNSYLVANIA STATE COLLEGE

At the Pennsylvania State College, State College, Pa., the members of the American Association for the Advancement of Science, numbering about forty, met for dinner at the University Club on May 20. Professor A. J. Wood, of the school of engineering, presided. The speaker of the evening, Dr. Ira N. Hollis, president of the Worcester Polytechnic Institute, outlined the types of research suitable for educational institutions as differentiated from the purely applied types of investigations more appropriately undertaken by commercial firms. Dr. Hollis regretted that so much of the scientific effort of this age has had to go into methods of destruction of all that civilization has built up, and spoke in the highest terms of the utility of such researches as that of Professor Michelson in perfecting methods of accurate astronomical measurements which aid humanity in a comprehension of the immensity of the universe.

A discussion of the status and the prospects for scientific research at the institution was led by the deans of the various schools and the president of the college. A committee will plan for further meetings next year.

SCIENTIFIC NOTES AND NEWS

Columbia University at its commencement exercises conferred the degree of doctor of science on Mme. Curie, Dr. John C. Merriam, president of the Carnegie Institution of Washington, and Dr. Samuel W. Lambert, dean emeritus of the school of medicine. The degree of doctor of laws was conferred on Dr. James Rowland Angell, president elect of Yale University. The candidates were presented by Dr. James F. Kemp, professor of geology.

The Case School of Applied Science has conferred the doctorate of science on Albert Sauveur, professor of metallurgy and metallography in Harvard University.

Professor John M. Coulter, of the University of Chicago, and Dr. Samuel Garman, of the Harvard Museum of Comparative Zoology, have been elected foreign members of the Linnean Society of London.

The Franklin Institute has conferred its Franklin medal and certificate of honorary membership on Professor Charles Fabry, of the University of Paris, for his studies in the field of light radiation.

Professor Albert Einstein sailed for Liverpool on the *Celtic* on May 30. He will deliver the Adamson lecture of the University of Manchester. He will afterwards lecture at King's College, London, and other institutions.

Mme. Curie was given on May 26 the degree of doctor of laws by the University of Pittsburgh, being presented by Dr. W. J. Holland. During the day she visited the laboratories where was refined the gram of radium presented to her by President Harding on behalf of American women. On the following day she went to Canonsburg, Pa., to inspect the plant where the ore from which radium is obtained passes through the initial processes of

reduction. Previously Mme. Curie had spent two hours at the plant of the Welsbach Company, Gloucester, N. J., and the company presented her with 50 milligrams of mesothorium. Mme. Curie, accompanied by her daughters, is now visiting the Grand Canyon and the Yellowstone Park.

The Rockefeller Foundation gave a dinner in honor of Dr. Carlos Chagas, head of the department of health in the Republic of Brazil, at the Waldorf-Astoria, on May 20. Dr. George E. Vincent presided as toastmaster, and addresses of welcome were made by John D. Rockefeller, Jr., Dr. Hermann M. Biggs, Dr. Paulo de Proenca and the Brazilian ambassador to the United States. Dr. Chagas, director of the Institute Oswaldo Cruz, Rio de Janeiro, gave a series of three lectures on "American trypanosomiasis" at the Harvard Medical School, May 26 and 27.

We learn from *Nature* that the presentation of the first award of the Kelvin medal was made by the Right Hon. A. J. Balfour in the hall of the Institution of Civil Engineers to Dr. W. C. Unwin on May 4. The medal was founded in 1914, principally by British and American engineers, to commemorate the achievements of Lord Kelvin in those branches of science which are especially applicable to engineering.

A commission of five engineers has been appointed to visit England in June to present the John Fritz medal to Sir John Hadfield, in recognition of his scientific research work. The members of the commission are as follows: Dr. Ira N. Hollis, president of Worcester Polytechnic Institute; Charles T. Main, of Boston, representing the American Society of Civil Engineers; Col. Arthur S. Dwight, of New York, representing the American Institute of Mining and Metallurgical Engineers; Ambrose Swasey, of Cleveland, of the John Fritz medal award board and the American Society of Mechanical Engineers, and Dr. F. B. Jewett, of New York, of the American Institute of Electrical Engineers.

President Harding, on June 3, designated Major Lawrence Martin as the representative of the Department of State on the United States Geographic Board.

Mr. Frank C. Baker, curator of the Museum of Natural History, University of Illinois, will spend the summer in Wisconsin, continuing his study of the molluscan fauna under the auspices of the Wisconsin Geological and Natural History Survey.

Arthur D. Little, Inc., announce that Chester M. Clark, formerly head of the corporation department of Stone & Webster, has been elected treasurer. Merton R. Sumner has been appointed chief engineer. Mr. Sumner was formerly chief engineer for New England of Fred T. Ley & Company, and more recently of the Fuller Industrial Engineering Corporation.

The centenary of Bloomingdale Hospital at White Plains, N. Y., for the treatment of nervous and mental disorders, was celebrated on May 26. A special program of addresses had been arranged by Dr. William L. Russell, medical superintendent, for the morning session, and in the afternoon there were tableaux showing the origin of the asylum, its growth and the development of science in the treatment of the insane. Addresses were made by Dr. Pierre Janet, professor in the College of France, Paris; Dr. Richard G. Rowe, director of the Neuro-psychiatric Hospital, London; Dr. Llewellys F. Barker, of the Johns Hopkins Medical School, and Dr. Adolf Meyer, professor of psychiatry in the Johns Hopkins Medical School.

Professor William Crocker, in charge of the plant physiology department of the University of Chicago and director of the Thompson Institute for Plant Research at Yonkers, New York, gave an address on "The physiology of seed germination" before the biology club of the University of Minnesota at University Farm on May 16. The following afternoon Professor Crocker spoke on an "Effective attack on plant physiological problems" before the experiment station staff and other faculty men.

A lecture entitled "The study of organic reactions occurring in living matter" was de-

livered by Dr. Treat B. Johnson, professor of organic chemistry at Yale University, before the Philadelphia section of the American Chemical Society on the evening of May 14.

DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington, delivered a lecture at the State University of Iowa in April, entitled "Recent researches on the antiquity of man in California." He also addressed the Geology Club on "The Fauna of Rancho La Brea."

THE committee organized in 1911 by the late Professor MacGregor to promote a memorial to Professor Tait in the form of a second chair of natural philosophy at Edinburgh, reports that the Tait chair will shortly be established.

CHARLES PICKERING BOWDITCH, known for his research in the field of archeology, died on June 1, in his seventy-ninth year.

THE death is announced of Abbott Thayer, the distinguished artist, known also for his studies of protective coloration.

DR. E. J. MILLS, F.R.S., emeritus professor of technical chemistry in the Royal Technical College, Glasgow, died on April 21, at seventy-nine years of age.

THE American Society of Mechanical Engineers extended an invitation to members of the American Association for the Advancement of Science, to attend the May meeting of the Society at Chicago. The program of this meeting gave special emphasis to the problems of Chicago as a mid-western rail-water gateway. Two excursions were planned: one to McCook Field, for those interested in aeronautics, and the other to the Rock Island Arsenal.

THE Engineering Foundation assumes responsibility for sending the following note to the daily press: "Dr. Charles Benson Davis, of New York City, claims in a paper which he has prepared and submitted to Engineering Foundation, that he can make and has made some of the chemical elements, such as gold, silver, platinum and copper, by transmutation of a common element. He has shown samples of the metals he claims to have made to members of the Engineering Foundation in New York City, and has requested that body to investigate his claims and his methods. Dr. Davis is a reputable chemist, a member of the Society of Chemical Industry, a Fellow of the British Chemical Society, and an Honorary Member of the Société Académique d' Histoire Internationale. He is the author of several papers which have been published in chemical journals."

DR. EDWARD A. SPITZKA, formerly professor of anatomy at Jefferson Medical College, Philadelphia, has donated to the U. S. National Museum his collection of brains of distinguished persons.

WE learn from the *Journal* of the American Medical Association that at the annual meeting of the New York Association for Medical Education held at the Academy of Medicine on March 7, the by-laws were amended and the board of directors was reconstituted to apportion the control of the association's affairs to the five medical schools of greater New York; namely, Columbia University, College of Physicians and Surgeons; Cornell University Medical College; the Long Island College Hospital; the New York Post-Graduate Medical School and Hospital, and the University and Bellevue Hospital Medical College. This means that for the first time in the history of New York City the five medical schools will cooperate to develop New York City as a medical teaching center. The mayor, the commissioner of health, and the commissioner of public welfare are ex-officio members of the board of directors. Unnecessary duplication of courses of instruction by the several medical schools will be done away with. New courses and a higher type of graduate work will be instituted. The new officers of the association are: president, Dr. Haven Emerson, formerly health commissioner of New York City, and at present in charge of the War Risk Bureau; secretary, Dr. Otto V. Huffman, at present associate professor of medicine at the New York Post-Graduate Medical School and Hospital, formerly secretary of the state board of medical examiners, and secretary-treasurer of the Federation of

State Medical Boards of the United States, and formerly dean of the Long Island College Hospital; treasurer, Dr. George W. Kosmak, attending surgeon of the Lying-In Hospital, and formerly secretary of the American Association of Obstetricians.

UNIVERSITY AND EDUCATIONAL NEWS

A dormitory for foreign students at Columbia University and other schools in New York has been made possible through a gift promised to members of the Cosmopolitan Club, an organization of students in Columbia and New York University. Plans for the dormitory provide for a building of 500 rooms to be erected at a cost approximating $1,000,000, on Riverside Drive opposite Grant's tomb. The newspapers report that the donor is John D. Rockefeller, Jr.

Dr. F. S. Harris, director and agronomist of the Utah Agricultural Experiment Station and professor of agronomy at the Utah Agricultural College, has resigned to become president of the Brigham Young University, at Provo, Utah, where he succeeds Dr. George H. Brimhall, who has been made president emeritus. Professor Wm. Peterson, station geologist and professor of geology in the college, has been appointed to succeed Dr. Harris as director of the station.

Dr. Nathan Fasten, who went to the Oregon Agricultural College last September from the University of Washington, has been promoted to the headship of the department of zoology.

Dr. John W. M. Bunker, who has been for several years at the head of the bacteriological department of the Digestive Ferments Company of Detroit, has been elected assistant professor of biochemistry and physiology at the Massachusetts Institute of Technology.

DISCUSSION AND CORRESPONDENCE

CONCERNING RECENT AURORAS, MAY 13 AND MAY 14, 1921

To the Editor of Science: On the evening of May 13, 1921, there occurred a great aurora, not visible here on account of clouds, but again on the evening of May 14 there was another great display visible here in spite of the half moon and a low-lying fog which tended to spoil the visibility. As in other great auroras, the great bundles of streamers appeared to converge toward the zenith from the south as well as from the north, east and west. The sky at times was virtually covered with auroral light. The outburst of May 13 caused great disturbance to telegraph and telephone wire transmission and must have been of unusual magnitude. All the effects noted in the aurora of May 14 a day later conformed to the perspective ideas, pointed out in my paper, "Inferences concerning auroras," read at the Boston meeting of the National Academy of Sciences on November 14, 1916, and published in its *Proceedings*, Vol. 3, pp. 1–7, January, 1917.

It is rarely that one great aurora follows so closely on the heels of another and at an interval so short as a day. In fact I have no record or recollection of such a happening in my time of observation, which now extends over fifty years, more or less. Hence the conditions lead to the inquiry whether any unusual condition existed in this instance.

An examination of the solar surface appears to provide, or at least suggest, a possible explanation, and at the same time throw light on the nature of the relation of the aurora to the solar disturbances.

On May 15 there were to be seen on the solar surface two large spot areas, separated by an interval of about one-fourteenth of the diameter of the sun, the one following the other as the sun revolved. These two spot areas, quite distinct from each other, were nearly round, the first a single spot, the second a compact group with a much disturbed area adjacent. They were located near the center of the solar disc.

As the solar revolution takes place in nearly 26 days, the interval between the spots appears to be approximately one day of the surface movement.

This means that in about one day the sec-

ond spot would replace the first in relation to the earth. If the first spot gave rise to emission of ions, radially, which in its orbital motion the earth reached and in which it became enveloped, the aurora of May 13 was possibly the result. The same relation repeated a day later by the second spot replacing the first would account for the aurora of May 14.

The relation of the two auroras in time, and the sequence of spot positions on the revolving sun are significant to say the least.

In this connection it may be noted that the great aurora of March 22, 1920, had a very long and unusual duration, beginning early in the evening of that day and continuing all night, even being observed just before sunrise on the 23d. It may have continued during part of that day, invisibly of course. At that time an examination of the solar surface disclosed a remarkably elongated spot area or chain of spots, and at each end of the chain or elongated group was a well-marked rounded spot. The group was fairly uniform in width extending in a direction nearly parallel to the solar equator, and its length would amply account for the long continuance of the aurora if emanations were pouring out from the whole group as it revolved with the the sun. Moreover, its advance past the meridian of the sun was apparently much the same before the aurora as with the two spots believed to have caused the auroras of this year on May 13 and 14. Such an advance points to a period (several hours possibly) required for the ionic emanations from the spot area to traverse the radius of the earth's orbit, from the sun.

Another matter of interest may be mentioned. In many auroras, especially during the greater outbursts, there occurs at times the peculiar streaming upward, as if a luminous wave was running up toward the zenith crown; a sort of flaming effect. The motion is fairly rapid, perhaps one half second being required to traverse the length of the streamer. The point I wish to make is that the apparent velocity of this wave-like luminosity upward seems to be constant in all auroras that I have witnessed and in which it was possible to make an estimation. This should be confirmed or denied by measurement, for those streamers which bear the same relation to the observer, as variations in distance away may affect the result.

ELIHU THOMSON

SWAMPSCOTT, MASS.,
May 16, 1921

THE LANDSLIDE NEAR MONT BLANC

THE March *Bulletin* of the Royal Italian Geographical Society contains an account, well illustrated with map and photographs, by Professor U. Valbusa of the landslides near Mt. Blanc which occurred on the 14th and 19th of November last and made much stir in the newspapers, even to the point of exciting fear that the round-topped "monarch of mountains" had lost some of its height (4,807 meters). Such was by no means the case, as the head of the slide was on the eastern side of the subordinate dome known as Mt. Blanc de Courmayeur (4,709 m.), two kilometers east of and nearly 500 meters lower than the main mountain dome. Granite rock masses about half a square kilometer in total slanting area, were dislodged from the oversteepened side of an east-facing spur, the top of the gray slide-scar being a little lower than the terminal point of the spur which has an altitude of 4,381 meters. The detached rock masses first slid down into a second-order cirque of small size between the spur of origin and the Aiguille blanche de Péteret, near by on the southeast; there they turned a short distance northeastward and descended from the hanging outlet of the small cirque to a level of about 3,200 meters on the Brenva glacier at the western side of the great first-order cirque in which this glacier gathers its névé branches, and from which a narrower glacial tongue cascades southeastward into the over-deepened trough—locally known as the Allée blanche—of the uppermost Dora Baltea. On reaching the main glacier beneath the small cirque, the slide turned to the right, and gathering ice as it rushed along spread over the whole 3-kilometer breadth of

the glacier at the cirque front, even dashing a little upward on the opposite mountain side; and then, rushing down the steep glacial cascade where it cut off séracs and clogged crevasses, it divided on the convex surface of the lower glacier and overran both lateral moraines but failed to reach the mid-extremity of the tongue on the floor of the Allée blanche. The total distance traversed by the slide was about 8 kilometers according to the map, but only 5 according to the text; the total descent was from altitude 4,300 to 1,500 meters. The time of descent of the first slide on Nov. 14, as estimated by eye witnesses, was between 2 and 3 minutes; the velocity of movement was the greater because winter snows had not yet fallen on the ice in the great cirque. The volume of the slide was roughly estimated at between 4,000,000 and 5,000,000 cubic meters. Dust of rock and ice was spread by the wind blast of the slide, right and left of its course on the glacier and the mountain flanks, for a width of a kilometer or more; trees were overturned by the blast outside of the lower lateral moraines; a temporary lakelet was formed where the right lower branch of the slide, crossing the trough floor and ascending a little on the farther side, obstructed the Dora Baltea. The slide was evidently one of those spasmodic efforts by which the Alpine mountain faces, over-steepened by glacial sapping, try from time to time to regain more moderate slopes, such as they had in Preglacial time; but the volume of the fallen rock was but a trifling fraction of the spur from which it was detached.

W. M. D.

EXTRA-MUNDANE LIFE: A COMMENT

To the Editor of Science: In discussing the highly speculative subject of intelligent life in other worlds it is well to keep in mind two serviceable precepts of scientific reasoning: First, failure to prove that *A* is *B* is not a proof that *A* is not *B*. Thus, failure to furnish evidence that other worlds are inhabited by intelligent creatures is not to be construed as proof that such extramundane life does not exist. Second, of two discordant propositions: *A* is *B*; *A* is *C*; one of which must be true and for neither of which any evidence is forthcoming, we are intellectually bound to accord hospitality—not adoption but hospitality—to the one which is marked by the greater likelihood. Viewed without anthropometric bias this earth is, as we know, one of the less important members of the system to which it primarily belongs—a system dominated by a single undersized yellow star. If we had a time word corresponding to the space word *parsec,* and also had more definite geological knowledge of the past and future duration of this planet, we might express quantitatively the fact that the human race is relatively a mere episode in the history of the planet itself; while our increasing knowledge of the Milky Way with its encircled disk of stars must convince us that our solar system is, in turn, only an incident in the history of the stellar system to which it belongs. Which is more probable, that this one insignificant planet is the only world in which creatures capable of feeling and knowing have originated and developed, or that multitudes of other worlds have afforded both conditions and cause for life, including intelligent life, and are the homes of beings of both physical and mental parts. The latter supposition seems to be invested with incomparably greater likelihood.

Ellen Hayes

Wellesley, Mass.,
May 22

SCIENTIFIC BOOKS

The Health of the Industrial Worker. By Edgar L. Collis and Major Greenwood, containing a chapter on Reclamation of the Disabled by Arthur J. Collis and an introduction by Sir George Newman. London, J. & A. Churchill, 1921.

The appearance of the first English book on industrial hygiene could not have been more happily timed. With a combination of an industrial depression and a glutted labor market there is a widespread tendency among American managers to scrap the elaborate personnel machinery established during the war—"to safeguard the health and capacity of the

workmen . . . by sensible observance of the facts and teachings of physiological science."

The authors form a peculiarly authoritative combination. As late H. M. Medical Inspector of Factories, member of the Health of Munition Workers Committee and Director of Welfare and Health under the Ministry of Munitions, Dr. E. L. Collis brings to his task an unusual background of practical experience in preventive medicine and industry. Dr. Major Greenwood is probably the foremost British medical statistician. Both authors are members of the Industrial Fatigue Research Board.

The book is divided into four parts. In the first section an historical review of British industrial conditions preceding the eighteenth century is followed by an account of industrial legislation from the famous Ordinance of Laborers in 1349, following the Black Death, to the recent (1911) Coal Miners Act and Workmen's Compensation (Silicosis) Act of 1918. The first section closes with two valuable chapters on the utilization of statistical methods in industrial preventive medicine and the effects of industrial employment upon health as indicated by vital statistics. A study of the mortality and accident rates in the English coalfields has brought out a most suggestive correlation between the percentage of miners who voted in favor of a general strike in August, 1920, and the regional mortality distribution. In Nottinghamshire where deaths and accidents are at a minimum, only 55 per cent. of the miners favored a general strike while in Lancashire where conditions are the worst of any English coalfield, unrest was likewise at a maximum since 89.7 per cent. of the miners voted to strike. These figures indicate a deep-lying relation betwen social unrest and health conditions.

In the second part of the book a chapter is devoted to each of the following subjects: Fatigue, tuberculosis, cancer, accidents and the industrial employment of women.

> No matter in the whole field of industrial hygiene is of more fundamental importance than the occurrence of fatigue. Researches . . . into the way in which the human machine works, are showing that optimum output is obtained by not allowing fatigue to exceed physiological limits: that the goal of the economist—output—can be best attained through the same agencies as allow the medical man to obtain his objective—health.

The authors place little faith in the so-called direct tests for fatigue and caution against conclusions regarding fatigue that have been drawn from output, sickness and turnover figures, except in cases where working conditions are remarkably uniform.

The problem of industrial tuberculosis is summed up as follows:

> Not through any special intensive measures of campaigning against the tubercle bacillus, not even by the segregation of the actively tuberculous, does there seem any real hope of salvation. We have to improve the homes of the working classes in the first place—it is a sound popular instinct that inspires the popular outcry against urban and even rural housing conditions: in the second place, we have to ensure better factory conditions. We require regulations of the hours and intensity of work, of the physical characters of the atmosphere, and of the quantity and quality of the meals taken, so that the workman returning home shall not reach it in a condition of definitely lowered resistance to an infection which must still be regarded as ubiquitous.

Pathological fatigue, inadequate ventilation and insufficient food are believed to be the three outstanding disposing factors to tuberculosis among industrial workers.

Although tuberculosis has been steadily decreasing, "the sudden change which has taken place in the conditions of life consequent upon the development of modern industry, has been associated with a rapid rise in cancer mortality, and this rise is greatest where modern industry is most developed." In a selected group of occupations (1900–02) the mortality from cancer in England and Wales was greatest among chimney sweeps and seamen and least among farmers and grocers. Chimney sweeps' cancer seems to be directly associated with their occupation; in Belgium, where coal like English coal is used, there is almost complete immunity, but great care is taken to prevent contact with soot. No explanation is offered for the increasing cancer

mortality which parallels advancing industrialism.

A study of British industrial accident statistics for 1913 has shown that more fatalities resulted from persons falling than from machinery moved by mechanical power. This fact suggests a high proportion of preventable accidents and further studies have indeed shown that 60 to 80 per cent. of all industrial accidents are apparently due to mistakes on the part of the workers. Safeguarding of machinery alone has not been found to reduce accidents more than 10 per cent.—a result which conforms with American experience. The interesting studies of Greenwood and Woods regarding predisposition to accidents are presented in considerable detail and additional evidence is advanced corroborating their conclusion that a trivial accident indicates a susceptible worker.

> A worker who has had three trivial accidents is a more dangerous person than one who has had a single bad wound.

In the chapter on the industrial employment of women the authors have presented a thoughtful analysis of the physical, physiological and psychological aptitudes and shortcomings of women. The commonly accepted physical inferiority of women they believe may be due to lack of physical training rather than actual structural capacity. The problem of the expectant mother was successfully met by the Ministry of Munitions by establishing a light employment dêpot.

> Overalls and gloves were made and mended and other sewing work was done by expectant mothers drawn from several factories in a district. The hours of work were shorter than normal, and the workers were paid on a time basis. Milk was given in the morning, a good meal mid-day, tea in the afternoon, and a rest room provided.—The women readily availed themselves of these facilities; lost time was negligible, and work was so well done that the dêpot was a financial success.

Although the authors admit "that the effect of plumbism in causing miscarriage and still births is a sufficient reason for excluding females from exposure to lead fumes . . ." they "are unaware of any scientific evidence in support of the alleged sexual proclivity." This conclusion is contrary to the findings of Oliver, Legge and Goodby.

The third part of the book consists of a practical discussion of industrial food requirements, ventilation, lighting and general sanitary accommodations. Attention is again directed to the disproportionately high percentage of wages required for the purchase of adequate food in the case of workers on "heavy jobs," jobs that require 3,800 calories as compared with 2,800 calories for light work. According to the calculations of Greenwood, Hodson and Tebb workers in the former class must spend nearly 13 s. weekly for food alone while in the latter case 10 s. will suffice. The practical problem is complicated by the fact that remuneration is less in the case of heavy jobs than for operations needing many fewer calories. In calculating working men's budgets the physiological demands of specific occupations must therefore be taken into consideration.

The value of the chapter on ventilation might have been considerably enhanced by a discussion of some of the methods for dust determination and the presentation of E. V. Hill's "zone of comfort" chart. The report of the New York Ventilation Commission should certainly be included in the bibliography. On page 327, Fig. 26-B presents a somewhat unfortunate example of "good lighting." The intense local illumination and the consequent deep shadows and contrasts are certainly not in keeping with the best modern practise. American experience has shown that a high general illumination with local illumination reduced to a minimum gives the most satisfactory results.

The fourth section of the book will be of particular interest to industrial physicians and nurses, personnel managers and social service workers. In the opinion of the reviewer a discussion of the physical standardization of jobs, for example by Martin's method, would have been a welcome addition to the chapter on "Supervision of Industrial Health." There is far too great a tendency to depend upon such qualifications as "short

and wiry" or "tall and flabby" (p. 381) in placing prospective workers. What we have to know is the limits of physical strength required for specific jobs. Similarly the question of heart efficiency as studied by Lowsley, Crampton and Schneider in this country would be of interest to the industrial physician. The omission of the nine figures illustrating the application of iodine and finger bandages (pp. 397–400) would provide ample space for such a discussion.

The maintenance of high production in any field of activity depends upon the health of the workers. Industrial hygiene need therefore make no appeal to the charity or humanity of industrial managers. It is primarily good business. Efficient, healthy, productive men and women have a social value whether their production is for service or for profits. Under any system of social organization industrial hygiene must therefore play a leading rôle in the future development of the world's industry.

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SPECIAL ARTICLES

SOIL ACIDITY THE RESULTANT OF CHEMICAL PHENOMENA

SALTS of strong acids with strong bases, of strong acids with weak bases, of weak acids with strong bases, of weak acids with weak bases, calcium hydroxide, the lowering of the freezing point, the catalysis of esters and the hydrogen electrode are all in use in one or another of the various methods advocated for the determination of "soil acidity." The results obtained by the different methods show that the condition of a soil at any time can be considered as its progress towards a constantly changing equilibrium according to the principles of Le Chatelier. It is to be remembered that those metallic elements occurring in ordinary soil stand at the top of the electromotive series of elements and that sodium and potassium compounds are all somewhat soluble; whereas, many calcium and magnesium compounds and most iron and aluminum compounds are very sparingly soluble in water.

The entirely different results obtained with different salts, and the large variations in soil acidity recently found by Conner when soils were kept at different moisture contents, make it certain that acid soils usually contain many soluble hydrolytic products which are controlled in amount by the quantity of alkaline earths and alkali metals present in the soil.

Carbon dioxide gas has long been known to cause many chemical changes in silicates and phosphates resulting in the increased solubilities of constituents making up these substances. The following results were obtained in recent investigations where soils in culture pots were treated with carbon dioxide. (The details of the different experiments will be published elsewhere.)

1. An "alkaline" sandy soil became acid in reaction in three months treatment with carbon dioxide gas.

2. The acidity of an acid brown silt loam was increased by treating the soil with carbon dioxide gas.

3. Liming this loam decreased its acidity but not as much as the original "lime requirement" determination (Veitch) indicated. One and one half times the total lime requirement did not neutralize the soil.

4. Where the soil was limed, limed and phosphated, and limed and treated with dried blood or sodium nitrate, carbon dioxide gas additions to the soil increased the soil acidity.

5. The specific conductivity of extracts obtained on treating the soils with conductivity water showed that the carbon dioxide gas had changed the constitution of the soil. The specific conductivity of the carbon dioxide treated soils was greater.

6. The acidity of the soils was lowered by extraction with conductivity water and the lowering was greater for those samples which had been subjected to the carbon dioxide treatments. A further evidence that the acidity was due to chemical changes in the soil was that the aluminum and iron in the normal potassium nitrate extracts was effected by the carbon dioxide treatments.

7. The volatile material determination was increased by carbon dioxide treatments, and since this increase could not be accounted for in the determination of total carbon, the carbon dioxide gas must have changed the water of constitution of some of the soil silicates.

8. The composition of the conductivity water extracts from the different soils varied as the fertilizer constituents added would theoretically replace substances known to be present in the soil.

9. The composition of the conductivity extracts from the carbon dioxide treated samples showed that the increased specific conductivity and acidities due to carbon dioxide treatment were associated with substances with low solubility and ionization constants present under conditions where hydrolysis readily took place.

The shifting of the acidity, the chemical changes in the soil and the soil extracts were in accordance with the solubilities of salts of metals high in the electromotive series and their tendencies to hydrolyze. The work leads to the conclusion that soil acidity is the resultant of hydrolytic mass action phenomena and thus the application of the exact amount of lime shown by any method can not be expected to give exact neutrality.

H. A. Noyes

Mellon Institute of Industrial Research,
University of Pittsburgh,
Pittsburgh, Pa.

THE AMERICAN MATHEMATICAL SOCIETY

The two hundred and sixteenth regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, April 23, 1921, extending through the usual morning and afternoon sessions. The attendance included sixty-seven members. Twenty-four new members were elected, and eleven applications for membership in the society were received.

The council voted to accept the invitation received at the February meeeting to hold the next annual meeting of the society at Toronto in connection with the meetings of the American Association for the Advancement of Science.

The following papers were read at this meeting:

On the gyroscope: W. F. Osgood.

Seven points in space and the eighth associated point: H. S. White.

Most general composition of polynomials: L. E. Dickson.

Number of real roots by Descartes' rule of signs: L. E. Dickson.

The Einstein solar field: L. P. Eisenhart.

A special kind of ruled surface: J. K. Whittemore.

On the theorems of Green and Gauss: V. C. Poor.

Pressure distribution around a breech-block: J. E. Rowe.

The mathematical theory of proportional representation. Third paper: E. V. Huntington.

On the apportionment of representatives. Second paper: F. W. Owens.

On the geometry of motion in a curved space of n dimensions: Joseph Lipka.

Note on an irregular expansion problem: Dunham Jackson.

Hyperspherical goniometry, with applications to the theory of correlation for n variables: James McMahon.

On the location of the roots of polynomials: J. L. Walsh.

The kernel of the Stieltjes integral corresponding to a completely continuous transformation: C. A. Fischer.

On a simple class of deductive systems: E. L. Post.

Topics in the theory of divergent series: W. A. Hurwitz.

A new vector method in integral equations: Norbert Wiener and F. L. Hitchcock.

On a certain type of system of ∞^2 curves: Jesse Douglas.

Concerning Laguerre's inversion: Jesse Douglas.

Closed connected point sets which are disconnected by the omission of a finite number of points: J. R. Kline.

The sum of a series as the solution of a differential equation: I. J. Schwatt.

Method for the summation of a general case of a deranged series: I. J. Schwatt.

Higher derivatives of functions of functions: I. J. Schwatt.

A covariant of three circles: A. B. Coble.

R. G. D. Richardson,
Secretary

SCIENCE

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SCIENCE

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A DECADE OF AMERICAN MATHEMATICS[1]

THE year just closing carries with it into the past another calendar decade, and the fact suggests that I take up with an audience representing the mathematical section of the American Association for the Advancement of Science and the two other mathematical societies meeting with it, a sketch of the progress of our science in this country during the decade. In doing this, I am led to reflect, when I think of the struggle that has marked the period, that though it is difficult to see how a thoughtful and disinterested person can enthuse over international rivalries in territory, dominion, trade advantages or other details of national prestige which are pregnant with dangers of destruction far beyond any possible advantages gained, a desire for national preeminence in scientific attainment is most wholesome and valuable.

I wish I might, therefore, compare the work of America during the decade with that of other countries. But even if this were fair, in view of the handicap the war has imposed on other countries, it would inevitably entail a sitting in judgment on questions of value over a field so broad, with so large a body of workers, that I have hesitated to assume the competency or to appropriate the time requisite to a proper performance of the task.

Instead, I am restricting myself to a review of some aspects of the work of this country alone, seeking to find the directions it has taken, to find some of the respects in which it has been weak, and in which strong, and to draw a few conclusions as to strengthening it in the future.

As to an anlysis of the contributions made, you will agree that since over 1,200 articles

[1] Address delivered as retiring vice-president of Section A of the American Association for the Advancement of Science, at Chicago, Dec. 29, 1920.

have been published since 1910, a detailed examination of those articles would be impossible. I have, as a matter of fact, obtained what I believe to be a fairly complete list of these artcles, and made a rough classification of them according to subject matter. Perhaps a quantitative comparison, based on numbers of pages, would have been more informative than one based merely on numbers of titles, but this too would have been open to criticism, and somewhat more difficult to obtain and digest. If you will bear in mind the meaning of the figures given, I have little fear that you will over-estimate their significance, or infer that I have any disposition to propose *any* quantitative test as the sole measure of the excellence of an individual's scientific output. On the contrary, I should prefer six pages of Fredholm's in the *Proceedings* of the Royal Academy of Science of Sweden of 1900 to scores of titles and many hundred pages that might be picked out from journals on the other side, or this side, of the water.

The limitations on the statistical field before us must first be stated. It includes no historical, biographical, or philosophical contributions, and only such in applied mathematics as were contributed by men primarily mathematicians, or appeared in journals devoted entirely to mathematics. It does not, moreover, contain articles contributed to journals of primarily didactic emphasis. Otherwise, it is intended to be complete, and contains contributions to a considerable number of foreign periodicals.

I wish to consider first the distribution of effort amongst various sub-fields of mathematics, and then to comment on some other aspects of interest presented by the data collected. In the matter of classification, in addition to certain customary headings, I have endeavored to separate out a few other classes of subjects of interest for the purposes in hand: first, certain topics whose present vitality and interest among mathematicians generally have been pointed out by Bliss, Van Vleck and others on occasions similar to this, and secondly some topics characteristically American in that Americans have taken a significant or preponderant part in their development. The distribution of titles among the headings selected follows, the numbers given being the percentages of the total number of titles found, or 1,258.

Algebra		
Groups	8.9	
Theory of numbers (including theory of irrationals)	6.0	
Theory of equations, matrices and determinants	4.8	
Higher complex algebras	1.8	
Modular analysis	1.7	
Invariants	1.4	
Combinatory analysis	1.1	
Probabilities and statistics	0.5	
	——	26.2
Analysis		
Theory of functions of one or more complex variables	6.4	
Theory of functions of a real variable	6.0	
Differential equations	4.3	
Sturmian problems, including Fourier Series	3.9	
General analysis, calcul fonctionel	2.9	
Integral equations	2.5	
Calculus of variations	2.3	
Analysis situs	2.1	
Theory of integration (Lebesgue, etc.)	2.0	
Difference equations	1.2	
Functions of infinitely many variables	1.1	
Point sets	1.0	
Other analysis	5.3	
	——	41.0
Geometry		
Metric differential geometry	6.0	
Analytical geometry of curves and surfaces	5.7	
Geometry of hyperspace	2.0	
Geometric transformations	1.4	
Projective differential geometry	1.7	
Configurations of a finite number of elements	1.0	
Geometry of forms	0.9	
Modular geometry	0.8	
Congruences and complexes	0.6	
Projective geometry (other than differential)	0.6	
Non-Euclidian geometry	0.5	
Other geometry	1.0	
	——	22.2

Applied mathematics		
Mechanics of continua (including potential theory and electro-magnetic phenomena)	4.7	
Kinematics and geometrical mechanics	1.7	
Celestial mechanics	1.7	
		8.1
Postulate theories		2.5
		100.0

It will be noticed that algebra and analysis constitute about two thirds of the whole, though this is not surprising in view of their large variety of phases and methods. Their share, however, is larger than in most countries, doubtless because of the prevailing tendencies in the countries to which our mathematicians went for training during the closing decades of the last century. I can not help feeling that a more even-balance would be desirable, because of the considerable suggestive help of the more intuitive branches of mathematics. Particularly does it seem regrettable that mathematical physics has not received more attention from mathematicians. It is true that some work has escaped a place in the data of the present study because it has not found its way into mathematical periodicals. For instance, a former member of the ordnance department has told me that he has in his possession over a hundred copies, mostly unpublished blue-prints, of articles on ballistics. But in view of the reputed practical temperament of the American people, in view of the racial traditions we might naturally have inherited from Great Britain, in view of its service to mathematics through its great suggestiveness of interesting problems, and in view of the service of mathematics, through mathematical physics, to physics and engineering, it does seem clear that a greater cultivation of this field in this country is most desirable. In fact, it might almost be considered as characteristic of the decade that this desideratum has been repeatedly and forcefully pointed out.

One reason for the situation which exists is to be found in our tendency to early and over specialization. Our physics departments are apt to load their students with their own courses, with emphasis on the experimental side, often content to have their graduates equipped with the calculus and a formal course in differential equations; while, on the other hand, little physics is usually required of students concentrating in mathematics. This is in part due to lack of mutual confidence, and in part to the student's own haste to receive his degree. Instruction in mathematical physics should be given by mathematical physicists. But until we have produced a more adequate supply of these, mathematician and physicist must cooperate. We can at least offer courses in those parts of mathematics which are of fundamental importance to physics, and in which details of rigor are replaced by cautions, in case of real danger, and in which a sympathetic attitude toward a desire to find out how nature works replaces a disdain for everything aside from the mathematical game, the instructor bearing in mind that the physicist has always the appeal to experiment with which to check his logic. On the other hand, it is probable that lecture courses in physics would be more frequented by students of mathematics if an attempt were consistently and constantly made to draw a clear line between mathematical consequences of previously established results and fresh appeals to experiment or new physical hypotheses. The more this distinction can be made, and the more the physical assumptions can be simplified and gathered into groups at the beginning of course or topic, the more will the course be likely to appeal to the student with mathematical predisposition.

Returning to our table for a glance at the distribution of effort we find the place occupied by algebra even higher than we should expect. This is largely due to the work of two men, Dickson, in the theory of numbers, of groups, and in allied subjects of algebra, and Miller, in the theory of groups. Other investigators whose work has enriched this field include Blichfeldt, Carmichael, Vandiver, Bell and Lehmer, in the theory of numbers; Glenn, Carmichael, Coble, Curtiss, Bennett, Metzler,

Wedderburn and Rice in the theory of equations, matrices and determinants; Miss Hazlett and Glenn in invariants and in modular analysis; W. A. Manning and H. H. Mitchell in the theory of groups; E. B. Wilson and Shaw in vector theory and higher complex algebras; Rietz and Dodd in probabilities and statistics; White, Coble and Cole in combinatory analysis.

Under the heading of analysis proper, in which the notion of limit plays a role, we find the theory of functions of complex variables taking first place. Our progress along these lines is largely due to Osgood, although there is also found a gratifying variety of contributions on conformal mapping, the theory of algebraic functions, and special analytic functions by Lefschetz, Gronwall, Haskins, and others. The theory of functions of a real variable would normally come higher on the list but for the fact that certain topics usually here included have been separated out, such as Fourier series, point-sets, etc. The theory of functions of a real variable is characterized by the fact that it has a larger number of individual contributors than the other topics, although the work of Blumberg deserves special notice. The field of differential equations, apart from Sturmian problems, has had, except for three fundamental papers of Birkhoff, comparatively little and scattered attention. Macmillan and Lipka have, however, written interesting papers on this topic. In the field of Sturmian problems including boundary value problems, oscillation and expansion problems, we may take distinct satisfaction in the valuable work of Bôcher, Richardson, Birkhoff, Jackson, and their pupils and followers. The calculus of variations, once characterized by Schwarz as the most interesting and difficult branch of mathematics, has had comparatively few devotees, but contributions of importance have been made by Bliss, certain of his pupils, by Dresden and E. V. Miles.

I wish now to speak briefly of certain comparatively new branches of analysis. Professor White once pointed out in an interesting statistical review of mathematical development[2] a distinct tendency to follow fashions. The reflection that men are apt to be stimulated by each other's work may rob this fact of some of its surprise, but the substantiality of the fact can not be denied. Of course when a new domain is opened up by fundamental discoveries, it is to be expected that sooner or later the event will be followed by a widespread and rapid development of that domain. An interesting example of a delay in such development is found in the fact that Fredholm's paper on integral equations, above alluded to, lay for two years unnoticed until the labors of Hilbert gave it its due prominence. New domains of the sort alluded to are at present: the still vital subject of integral equations, the related field of functions of infinitely many variables (though Hill and von Koch considerably antedate Fredholm), the theory of generalized integrals opened up by Lebesgue, general analysis, due to E. H. Moore, Fréchet and Volterra, and one or two other fields to be mentioned presently. It seems to me that in view of the general attention being given to these subjects, American interest in them has been distinctly less than it should have been. General analysis leads, with 2.9 per cent. of the total number of papers. The general analysis of Moore has been ably cultivated by his pupils, Hildebrand, Chittenden, and others, while the calcul fonctionel has had fewer devotees. But along the latter lines should be mentioned the papers of C. A. Fischer, Evans, and the two articles of Bliss inspired by his work in ballistics. The cultivation of integral equations in this country has been due to several influences. Besides the general theory of Moore, we find interest in the subject stimulated by Bôcher and Volterra, the contributions coming mainly from the pens of Mrs. Pell, Hurwitz, and Evans, respectively. The theory of functions of infinitely many variables receives more than one contribution each from but two authors, Hart and Daniell.

I have given a special place to analysis situs

[2] Science, new series, Vol. 42, pp. 105–113, 1915.

because it seems to me that the work of Poincaré and others, including Birkhoff in this country, has emphasized the growing importance of qualitative mathematics in dynamical problems. The showing here is good, including interesting contributions from Veblen, Alexander, Birkhoff, R. L. Moore, and Kline. The closely related topic of point sets, whose vital connection with geometry and dynamics was forcefully pointed out by Van Vleck in his address as retiring president of the American Mathematical Society in 1915, claims but one per cent. of the total number of titles, the articles on this subject coming from Van Vleck, R. L. Moore, Blumberg and Kline. In the theory of integration we find 1.2 per cent. of the titles, Bliss and Daniell being the principal contributors.

While geometry does not seem to have had its full share of attention, we are well represented in differential geometry, largely because of the labors of Eisenhart, Wylczynski, Kasner, G. M. Green, Graustein and others. Further branches of geometry in which Americans have labored productively are: the geometry of algebraic varieties, in which Lefschetz has done notable work; the geometry of special classes of curves and surfaces, cultivated by Snyder, White, Emch, Sisam, Ranum, Roe and others; the geometry of forms; modular geometry, by Dickson, Glenn and Coble; the geometry of hyperspace, by C. L. Moore and Eiesland; transformations, by Snyder, Sharpe and others; non-Euclidean geometry; while a number of memoirs on different aspects of geometry have been contributed by Coolidge.

The work in mathematical physics has been due almost solely to four men: Bateman, Gronwall, Webster and Roever. Progress in celestial mechanics is to be credited almost entirely to F. R. Moulton and his pupils and to Birkhoff. The work of Birkhoff in the field of dynamical systems has been conspicuous.

In postulate theory, the papers of Huntington, R. L. Moore, and Scheffer have aroused much interest.

The above review lays claim only to being a sketch, and doubtless overlooks single papers of real importance. It does, however, give some idea of the fields being cultivated, and of the more prominent figures in them. Not as an afterthought, but with singular pleasure, do I allude to several developments which are peculiarly American, in that they were largely initiated and cultivated on this side of the ocean: to Moore's general analysis already touched upon, and to Wilczynski's projective differential geometry, ably initiated by him and carried on by himself and pupils, and to the all too short-lived Green—to Kasner's geometrical mechanics, and to the theory of linear difference equations in the hands of Birkhoff, Carmichael and their pupils. While one might wish a more extensive cultivation of such branches as are largely indigenous, it seems to me that their very existence furnishes some evidence of the vitality of American mathematics, and a foundation for predictions that its importance is on the increase. Doubtless there are other evidences of the same sort of thing that have escaped my attention.

A few further remarks on the statistics gathered may be of interest. The 1,258 titles found were the contributions of 325 persons. Nearly half of this number contributed but one paper each. I think it fair to assume that two thirds of the latter had recently received their doctorates and were writing their first and last paper at the same time. This large "mortality" indicates a great waste of intellectual capital, and deserves careful consideration. Some of it means the diversion of energy of able investigators into the instruction of pupils who might be predicted to be unproductive, and some of it is due to the crushing out of scientific enthusiasm in really able young mathematicians by an unsympathetic or over-exacting environment. The "treatment indicated" must be decided upon in the individual cases.

I have heard the advice given to young scientists, that if they wish to show the greatest productivity, the best way to accomplish this is by a high degree of specialization. The results of the present study bear this out, though not to the extent one might anticipate.

For one third of the twelve most productive mathematicians have papers scattered over a half dozen different fields each. Doubtless the advice given is particularly apt in cases where industry is a more predominant characteristic than elements of genius. But it does seem as if actual productive experience in different domains did, in some cases, add to the mathematician's power, by suggesting ideas, analogies and methods. It seems to me also to have a steadying effect on one's sense of values. He who sits in judgment on the value of scientific work is in a precarious position. To be sure, it must be done, by editors, if not by others. I have sought for some time a satisfying criterion of values. Probably no absolute criterion exists. The best working test I have been able to find, both in my own judgment and in that of those mathematicians with whom I have discussed the question, is to be found in the degree of relationship of the investigation to be judged with other branches of mathematical or allied sciences whose vitality and interest are recognized. If this solution is at all an acceptable one, it is at once clear how experience in different fields may enhance the value of the worker's product.

It may be of interest to note, in these times of agitation for cooperative research, that less than 3 per cent. of the titles listed were of joint papers, and of these not one bore evidence of being inspired by the movement. While cooperative investigation in mathematics should have all the trial it can get, it is evident that men are not likely to take to it naturally in any great degree, though there have clearly been instances in which investigators, brought together by community of interest, have distinctly enhanced their product by collaboration.

In addition to publications in journals, there are the books which have appeared during the decade. The number of books on higher mathematics which Americans have published in this time barely exceeds three score. Titles of American books in the lists of current publications in higher mathematics are as needles in a haystack. The value to American mathematics of authoritative and up to date handbooks by American authors has been sufficiently emphasized to need no further comment here. The books which have appeared include a sufficient number of treatises of such excellence as to leave no doubts as to the capabilities of authorship in this country. Three, at least, of them, have been translated into French or German; two, written in these languages, enjoy large sales here and abroad. The problem is an economic one, and the desirability of subsidy encouragement has been pointed out. All I wish to do here, is to suggest the help each individual can give by buying such books whenever possible, and by recommending their purchase by libraries.

Our sketch of the decade should not terminate without mention of the fact that a half dozen Americans have been elected to foreign academies, and that in three instances Americans have been the recipients of prizes or medals from such organizations, and in a further instance, of an honorable mention. The foreign recognition in these cases has been amply merited. The point is, of course, that by reason of national pride, of habit, of language barriers, recognition must of necessity lag behind merit. But some conscious effort on our part may well be directed toward the attainment of deserved recognition. It seems incontrovertible that if a bit of mathematics is worth writing, it is worth writing to be read. Otherwise the author is guilty of usurping pages in the journals and space on library shelves to no purpose but the gratification of vanity. This is not the place to enter upon a discussion of style, but one or two aspects of the matter have forced themselves upon my attention in connection with the present study. Style as a whole is, and doubtless should be, individual, and its development is largely merely a matter of conscious purpose. Its fundamental element for the mathematician is, of course, clarity. But when one looks over the standard reviews of mathematical literature, and notices the extent to which the reviewer takes his cue from the author's opening lines—frequently contenting himself with citing the author's own estimate of his work, it becomes clear that particular emphasis in

writing should be laid upon the opening paragraph. I suggest that without exception the introduction should be framed about the thought "this is an interesting and worthwhile contribution" (if the author has not this conviction, he ought not to ask it of the editor); that it ought therefore to give the historical setting of the problem in hand, an indication of its relationship with other problems of established importance or of recognized interest, either in mathematics or in allied sciences, with a clear indication of the novelty claimed in results or methods or presentation. If the author will then outline his general course of reasoning, he will further enhance the readability of his paper. Similar remarks apply to the presentation of papers at meetings of scientific societies. A paper should be made interesting, or be read by title. As long as the author conceives it to be an act of merit merely to go through the form of presenting a paper, so long will he deserve to have his audience melt away to talk of really interesting things in the corridors. It is, to be sure, a difficult task to make a highly technical subject of general interest, but it can be done by a placing of emphasis more on setting and less on detail, and the effort is a scientific duty.

I have alluded to the question of values. There is another side to this question, or perhaps rather another aspect of values that must not be overlooked. I have heard the question raised as to where or when our American LaGranges are to appear. There is little doubt but that young men of a high degree of genius exist in this country in every generation. That more of them do not find their way into mathematics, or, having found their way, do not continue on and develop there, is, to a considerable extent, a matter of environment. By cultivating a background of productive scholarship, by cultivating an appreciation of productive scholarship, something can be done toward producing a favorable environment. Ususally men of genius are as sensitive to appreciation, as responsive to encouragement, as any one else. The geniuses must have their audience of appreciative scientists, the less gifted producers must have their audience of interested readers, and the science as a whole must have a hold on popular respect.

Now nothing enhances a man's mathematical interests like a share in the development of the science, even though the share have but slight intrinsic importance. It seems to me therefore that it is desirable to have means of publication of papers of minor importance—it being understood that in respect to content or method some novelty and merit is present—both because the encouragement thus given may at any time be the occasion of stimulating effort destined to become of high value, and because the interest engendered is likely, at the least, to become a support to the more effective producers.

Just as an enormous impetus to mathematical work in this country was nearly coincident with the foundation of the New York Mathematical Society, so also I think we may reasonably look for a distinct impetus from the founding of the Mathematical Association of America, whose successful launching has been one of the important scientific events of the decade, and which has already brought to light a lively group of mathematical interests beyond the hope even of the founders.

Various ways of external encouragement of mathematical science in America have recently been discussed. They include the items I have mentioned, the encouragement of publication both of books and periodicals, they include prizes for important contributions, and they include recommendations for diminishing the distractions which hamper the scientist in the way of excessive instruction and administration. While I do not wish to suggest that more effective means exist, nor to imply that such steps ought not to be seconded most heartily, I do wish to point out that each individual can throw his added influence into the scale and help materially and immediately, first by efforts to produce, in the faith that such efforts will certainly result in his being more vitally a scientist and a more enthusiastic teacher of his subject; second, by cultivating a discriminating sense of value, and endeavoring to throw his pro-

ductive efforts into the most important channels which promise him some success; and thirdly by realizing his duty to make the value and interest of his own work, and of his science in general, appeal as widely as possible.

O. D. Kellogg

SUMMARY OF A REPORT OF THE PERMANENT SECRETARY CONCERNING THE AFFAIRS OF THE ASSOCIATION, SUBMITTED TO THE EXECUTIVE COMMITTEE AT ITS MEETING, APRIL 24, 1921

The following paragraphs present the main features of the permanent secretary's report for the period from October 1, 1920, to March 31, 1921.

In accordance with a vote of the Council at Chicago, Doctor Sam F. Trelease was appointed assistant secretary, beginning January 1. The assistant secretary has thus far been engaged mainly in editorial work on the new membership list.

The new volume of the Summarized Proceedings is far advanced and will soon appear from the press. It is planned to be more useful and satisfactory than the earlier volumes. It will contain the constitution and by-laws of the association, the summarized reports of seven annual meetings—from 1914 to 1920 (with citation references to Science for the important official publications), and the complete membership list corrected to the date of printing. The list contains about 12,000 names and addresses. Subscriptions for the new volume were booked at the price of $1.00 to members, until December 1, 1920, since which date the price to members has been $1.50. Over 1,600 volumes have been paid for in advance. (The present price will be maintained until the date of actual publication, after which it will become $2 to members and $2.50 to nonmembers. Subscriptions and remittances should be sent to the Permanent Secretary of the American Association for the Advancement of Science, Smithsonian Institution, Washington, D. C.)

The American Mathematical Society, which was invited to become affiliated with the association at the Chicago meeting, has ratified this affiliation and is now an affiliated society. The roll of the society includes 313 members of the association, of which number 107 are association fellows. The society is therefore entitled to two representatives in the council of the association.

Two state academies of science, the Michigan Academy and the Oklahoma Academy, have been added to the list of affiliated academies through their election by the council at the Chicago meeting. Each affiliated academy is entitled to a representative in the association council.

(With the two academies that were affiliated by the action of the Executive Committee on April 24—the North Carolina Academy and the Maryland Academy—there are now twelve affiliated academies, named as follows: Illinois, Iowa, Kansas, Kentucky, Maryland, Michigan, Nebraska, New Orleans, North Carolina, Oklahoma, and Wisconsin.)

The arrangement for the affiliation of academies allows the academy to collect the annual association dues of its national members (members who are also members of the American Association) and allows it to retain, for its expenses all association entrance fees obtained through its efforts and also one dollar of each payment of association annual dues collected by it. The permanent secretary's office supplies each affiliated academy with printed and addressed statement cards for all of its national members and these are sent to the members of the academy, so as to be received October 1 of each year (the beginning of the association fiscal year). For each $5 payment received in response to this billing the academy transmits $4 to the office of the permanent secretary, who then orders the free journal for each member so paying. (The journal can not be ordered until the $4 remittance is in the hands of the permanent secretary.)—Immediately after its affiliation each newly affiliated academy receives from the permanent secretary's office a payment amounting to one dollar for each one of its national members who has already paid his association dues for the current year. When a member of the association becomes a member of an affiliated academy after its affiliation the acad-

Name of Academy and Time of Its Affiliation.	Academy Allowances for 1920	Academy Allowances for 1921 (to March 31)	No. of New Members Received through Academy (Sept. 30, 1920, to March 31, 1921)	No. of National Members of Academy (March 31, 1921)	No. of National Members in Arrears for Association Dues (March 31, 1921)[1]
Illinois (Feb. 20, 1920)	$187	$274	64	287	10
Iowa (April 24, 1920)	96	106	8	112	4
Kansas (April 24, 1920)	60	66	5	70	4
Kentucky (May 8, 1920)	23	43	12	43	0
Michigan (Dec. 27, 1920)	—	74	—	83	9
Nebraska (April 30, 1920)	100	98	2	117	18
New Orleans (May 21, 1918)	88	61	3	114	52
Ohio (May 14, 1920)	127	140	7	152	10
Oklahoma (Dec. 27, 1920)	—	18	2	23	3
Wisconsin (April 23, 1920)	74	116	45	190	10
Totals	$755	$996	148	1,191	120

emy is allowed to retain the usual dollar allowance *if it collects the annual association dues of such member after April 1,* but the allowance is *not effective for that year* if the member pays his dues before April 1.

The operation of academy affiliation is illustrated by the above table, for the years 1920 and 1921.

It appears that the affiliation arrangement for academies has thus far been very unprofitable in a financial way, but it is hoped that the financial loss by the association and the corresponding contributions toward the support of the academies may prove justifiable as expense incurred in promoting the advancement of science and education in the United States.

The present status of the membership of the association (March 31, 1921) is summarized below, together with corresponding data for 1920.

The expenses of the Chicago meeting, including those of the preliminary announcement, were nearly $4,000, of which about one-half was raised through local subscriptions secured by the Local Committee. The printing of the General Program cost $1,002.50 and the printing and mailing of the preliminary announcement cost $955.35.

Preparations for the annual meeting are exceptionally well in hand this year, the local committee having already begun its work, and

[1] The sum of the corresponding numbers in columns 3 and 6 does not agree exactly with the number in column 5, because members sometimes have to be transferred from the account of one academy to that of another because of change of residence.

Number of	March 31, 1920	Mar. 31, 1921
Active life members	353	350
Annual members credited with dues for current year	8,034	9,287
Members in good standing, total	8,387	9,637[2]
Members in arrears for two previous years and current year	915	424
Members in arrears for $2 on 1920 account and for current year	220	29
Members in arrears for one previous year and for current year	618	773
Members in arrears for current year only	2,163	1,085[3]
Names on list, total	12,303	11,948

CHANGES IN MEMBERSHIP FROM SEPTEMBER 30, 1920, TO MARCH 31, 1921

	By Death	By Resignation	Dropped October 1, 1920, for Non-Payment of Dues	Total
Loss from list	36	361	1,620[4]	2,017
Gains, new members	—	—	—	859
New loss from list	—	—	—	1,158

[2] On April 21, this number had been increased to 9,852.

[3] On April 21, this number had been decreased to 870.

[4] It should be noted that this number is considerably larger than the normal expectancy on account of dropping for nonpayment of dues. The list during 1920 still contained all those names that should ordinarily have been dropped at the beginning of that year. On October 1, 1920, names were dropped for which there was an arrearage of 3 years, as well as those for which there was an arrearage of 2 years.

it seems certain that the Toronto meeting will be very successful in every way.

Burton E. Livingston,
Permanent Secretary

THE EXECUTIVE COMMITTEE ON NATURAL RESOURCES

BEING THE UNION OF THE COMMITTEES APPOINTED BY THE NATIONAL ACADEMY OF SCIENCES, THE NATIONAL RESEARCH COUNCIL AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The following is the present membership of the Committee:

Representing the National Academy of Sciences
- John C. Merriam, president, the Carnegie Institution of Washington
- John M. Clarke, director, New York State Museum
- J. McKeen Cattell, Editor of Science

Representing the National Research Council
- John C. Merriam
- John M. Clarke
- J. McKeen Cattell
- Vernon Kellogg, secretary, National Research Council
- C. E. McClung, director, Zoological Laboratory, University of Pennsylvania

Representing the American Association for the Advancement of Science
- John C. Merriam
- Henry S. Graves, former chief, U. S. Forest Service
- Isaiah Bowman, director, American Geographical Society
- Barrington Moore, president, American Ecological Society
- V. E. Shelford, professor of zoology, University of Illinois

Chairman, John C. Merriam

Vice-chairman, John M. Clarke

Secretary, Albert L. Barrows, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

Assistant Secretary, Willard G. Van Name, American Museum of Natural History, New York, N. Y.

Program

The purpose in organizing this Executive Committee is to promote, by scientific effort and through education, the most reasonable use of our natural resources for the economic, industrial and social development of the country.

The American people have been richly endowed with natural wealth and have quickly availed themselves of their endowment. The first easy and quick production for the pressing needs of the growing population, followed by rapid strides toward the realization of wealth, have brought large elements of the natural resources to the danger line, some to more costly and lessened production, while others are threatened by extinction. Commercial production will of necessity be governed by economic law; use will be dependent on production, but both must be free of waste and governed by intelligent foresight. There are important natural resources whose commercial uses are less obvious but whose depletion is a grave disturbance of the balance of nature.

This is a problem of the public welfare. Its solution should marshal not only scientific knowledge and the economic interests of the country but also the moral forces of the body politic. Organized effort to safeguard our natural heritage must come quickly. As use becomes greater, abuse and wastage must be diminished.

This Executive Committee does not assume a supervisory attitude in matters of conservation but seeks to advise, coordinate and substantiate outstanding organizations. It sets forth the following program as expressive of its purpose:

1. The problem is a basic one in public welfare. It should therefore challenge intelligent attention, command public confidence and receive necessary financial support.

2. This movement is at present representative of the scientific membership and functions of its parent societies, the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science. The committee may be enlarged from time to time by the addition of members of experience and wisdom; but its work must be of a character truly to represent its parent organizations. It

should keep in close touch with their governing bodies, and annually present a report to their councils. The results of the work will carry the weight of the associated leaders of science in America.

3. Essential to the purposes of the undertaking is a competent and vigorous executive, composed of a director or executive secretary with necessary expert and clerical assistance. The functions of this executive are provisionally outlined thus:

(*a*) To assemble, classify and correlate all outstanding activities in the scientific and industrial conservation of natural resources; with the purpose of bringing these into effective juxtaposition and concentration and thus produce an active army of organized workers directed to a common end without duplication of effort or cost. The former is essentially statistical; the latter is directive and requires a skillful exercise of judicious procedure and tactful guidance.

(*b*) To effect active cooperation with the officers and directorates of existing organizations concerned with natural resources.

(*c*) To assemble available data relating to the status of our natural resources, to enlist therefor such industrial and other agencies as are actively engaged therewith, to interpret these data in relation to protection and reserve, as well as to the economic and social welfare of the state, and to provide a broad scientific basis for legislative action by the state and the federal government.

(*d*) To initiate and judiciously enforce by education recognition of the principle underlying the protection and use of natural resources.

It is held that this recognition can be made most effective and enduring by implantation in the minds of the children of the elementary schools; that in schools of higher grade, in colleges and universities, and in schools of engineering and applied science this principle can be enforced by correct teaching in already established courses. Extravagance of statement and emotionalism must be cautiously avoided. Teachers must themselves be taught not only to inculcate this principle but to do it wisely. Advantage must be taken of existing channels of educational approach through the state educational organizations and the state executives, in which the Division of States Relations of the National Research Council may helpfully cooperate.

It is held that the proper teaching of the conservation principle is a most effective safeguard for the future of this nation. This undertaking will therefore involve uninterrupted effort with the eventual aid of proper texts, the probable establishment of a bureau of lecturers who may reach the public outside the schools, and the utilization of all modern accessories to effective educational appeal.

Supplementary

Cost of the work.—The cost of the work is estimated as $25,000 per annum, distributed as follows:

Salaries		
Executive Officer	$10,000	
First Associate	5,000	
1 Clerk	1,600	
1 Clerk	1,500	
1 Clerk	1,400	
		$19,500
Traveling Expenses		2,000
Office Rent		1,000
Office Expenses		
Including telephone, telegrams, stationery, postage, etc.		500
Printing, Drafting and Contingent		1,800
Total		$25,000

Financing.—It is desirable, if possible, to secure a permanent fund of $500,000 whose income would be available for the work in contemplation. In that event, a separate foundation could be established, or the fund could be given to the National Academy, the National Research Council, or the American Association for the Advancement of Science with provision for the use of the income for the work of this committee.

In case the funds are in the form of annual contributions, it is desirable to plan in advance for a certain income to cover a period of not less than five or ten years. Reasonable

permanence should be given the project before its formal undertaking.

John M. Clarke,
Henry S. Graves,
Barrington Moore,
Committee on Program

June 3, 1921

SCIENTIFIC EVENTS

THE INCREASING USE OF UNITED STATES GEOLOGICAL SURVEY MAPS

The project of covering the 3,000,000 square miles of the United States with accurate topographic surveys was definitely adopted by the federal government in 1882. The project was large, and the work is even now less than half completed. The standards of accuracy and refinement in topographic surveying have been constantly raised by the topographic engineers of the United States Geological Survey, Department of the Interior, with the view of meeting adequately every use to which the maps can be put. The law provides for the sale of the maps made by the Geological Survey at the cost of printing, a charge that must be considered merely nominal when it is realized that the cost of an edition of a printed map may be only a small percentage of the cost of surveying the area it represents.

The government itself is making a large and increasing use of these topographic maps, but the expenditure of public funds for these surveys is otherwise fully warranted only as the public uses the maps. To promote this use, the Geological Survey has recently given more attention to the wider distribution of the maps.

The distribution of a government map depends largely upon publicity, though the necessity of adopting commercial business methods in handling orders for the maps when a demand is created must not be overlooked. To inform the public of the existence of authoritative maps published by the federal government a special effort is now being made to reach the communities in every area that is covered by a map, and to this end every map as issued is brought to the attention of the local and state press.

Other methods of promoting wider distribution involve the cooperation of boy-scout masters, schoolboys, and hotel managers, as well as of a large number of bookstores as local agents. Helpful publicity has also been gained through the voluntary cooperation of the press. The printing in a single publication of a brief statement regarding the Geological Survey's maps often results in orders for a hundred or more maps and many inquiries for the State index maps, which are sent free, showing the areas already mapped.

The periods of maximum demand for these government maps are the beginning of the vacation period and the beginning of the school year.

THE ROYAL SOCIETY CONVERSAZIONE[1]

The annual conversazione of the Royal Society was held at Burlington House on May 11, and was so well attended that it was practically impossible to see a tenth part of the exhibits and demonstrations. Fortunately arrangements are always made for an earlier press view of the latter. This year amongst the thirty-nine demonstrations figuring in the catalogue there was none having any direct bearing on medical science, though the exhibition contained much of great general interest. Mr. L. T. Hogben, of the Imperial College of Science, demonstrated the effects on tadpoles of feeding them with pineal gland. Hitherto there has been no proof of any physiological function exercised by the pineal body, but Mr. Hogben has succeeded in showing, in tadpoles at least, that it has some controlling power over the pigment cells. Macroscopic and microscopic preparations showed that in the pineal-fed tadpoles there is a very evident contraction of the melanophores, an effect that is not produced by feeding experiments with any other endocrine organ. Mr. C. Tate Regan, F.R.S., gave a demonstration of part of the life-history of the common eel, founded on the researches of Dr. J. Schmidt, who showed that the freshwater eel of Europe breeds in the Atlantic, southeast of Bermuda. A series of larvæ, from the middle and western North Atlantic, with long and slender pointed

[1] From *The British Medical Journal.*

teeth, were exhibited, together with a photograph of the metamorphosis into the elver. The accompanying models illustrated the changes from the yellow eel with its thick lips, small eye, and compact pectoral fin, into the thin-lipped, large-eyed silver eel with pointed pectoral fin, the latter form of eel being that which migrates to the ocean to become mature. Dr. John Rennie demonstrated the mite, now named *Tarsonemus woodi,* which has been claimed by Bruce White to be the causal agent of Isle of Wight disease in bees. White showed that the mites perforate the tracheæ, and by their numbers obstruct the spiracles and thus deprive the bees of the power of flight. Mr. J. E. Barnard gave a demonstration of the microscopic appearances of sections by ultra-violet light. Certain structures, owing to their differences in chemical composition, give different fluorescent tints, and the images obtained are often dissimilar to those obtained by ordinary staining methods. The light filter used was a glass made by Chance, which is transparent to the ultra-violet radiations, and the quartz substage condenser was of the "dark-ground" type. A most interesting and instructive astronomical model designed for educational purposes was exhibited by Dr. William Wilson. This model, which has received great praise from leading astronomers and teachers, not only demonstrates the more familiar motions of the sun, earth, and moon, and the various phenomena resulting therefrom, but is capable of simple analyses of each particular motion. The apparatus is most ingenious.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE E. DE SCHWEINITZ, professor of ophthalmology at the University of Pennsylvania, was elected president of the American Medical Association at the meeting held last week in Boston. Other officers were elected as follows: Frank B. Wynn, of Indianapolis, vice-president; Dr. Alexander R. Craig, of Chicago, and Dr. William Allen Pusey, of Chicago, were reelected secretary and treasurer, respectively.

AT the recent commencement of New York University, the degree of Doctor of Laws was conferred on Dr. George David Stewart, professor of surgery at the university.

THE honorary degree of Doctor of Science was conferred upon C. L. Marlatt, assistant chief of the Federal Bureau of Entomology, and chairman of the Federal Horticultural Board, by the Kansas State Agricultural College at its fifty-eighth commencement on June 2, "in recognition of his contributions to our knowledge of insects and his efficient services in initiating the policies and directing the work of the Federal Horticultural Board."

THE degree of doctor of engineering will be conferred by the Stevens Institute of Technology on Dr. Sven Wingquist, the Swedish engineer, who comes to the United States by invitation of the institute on the occasion of the celebration of its fiftieth anniversary.

DR. WM. CURTIS FARABEE, president of the American Anthropological Association, has been elected a corresponding member of the National Academy of History, Ecuador.

THE Adams prize of the University of Cambridge has been awarded to Dr. W. M. Hicks, St. John's College.

THE friends and former students of Professor A. Swaen are planning to place a tablet in his honor in the Institute of Anatomy at the University of Liége where he has taught for thirty years.

DR. T. W. FULTON, scientific superintendent of the Fishery Board for Scotland, has retired after a service of thirty-four years.

MR. BRADLEY STOUGHTON has resigned the secretaryship of the American Institute of Mining Engineers, which he has held since 1913. Mr. Stoughton's resignation is in accordance with his personal belief that the office of secretary of the institute should not be permanent, since too long a tenure of office is likely to create relations that can not be terminated agreeably. During Mr. Stoughton's tenure the membership of the institute has increased from 3,500 to over 9,000.

The National Academy of Sciences has appropriated from the J. Lawrence Smith Fund $300 for the preparation of manuscripts by Mabel Weil on the work of the late Professor C. C. Trowbridge accomplished under a previous grant, on meteor trains and aurora phenomena.

The Committee on Scientific Research of the American Medical Association has granted Professor Frank P. Underhill, of Yale University, the sum of $300 for expenses in connection with an investigation on the metabolism of inorganic salts, and $400 to Dr. Wm. H. Welker, of the University of Illinois, College of Medicine, for assistance in an investigation on the fractionation of bacterial proteins.

Officers for 1921–1922 of the Boston Society of Natural History have been elected as follows: *President,* W. Cameron Forbes; *Vice-presidents,* Nathaniel T. Kidder, William M. Wheeler, Theodore Lyman; *Secretary,* Glover M. Allen; *Treasurer,* William A. Jeffries; *Councilors for three years,* Reginald A. Daly, Merritt L. Fernald, William L. W. Field, George H. Parker, John C. Phillips, Charles H. Taylor, Jr., Edward Wigglesworth, Miss M. A. Willcox.

At the annual meeting in April of the California Botanical Society the following officers were elected: *President,* Dr. W. L. Jepson, professor of botany in the University of California; *First Vice-president,* Dr. L. R. Abrams, associate professor of botany in Stanford University; *Second Vice-president,* Mr. W. W. Mackie, assistant professor of agronomy in the University of California; *Secretary,* Mr. H. E. McMinn, professor of botany in Mills College; *Treasurer,* Mrs. Adeline Frederick, Berkeley, California.

Officers of the Southwestern Geological Society elected at the March meeting of the society at Tulsa, Oklahoma, were as follows: E. H. Sellards, president; C. Max Bauer, vice-president; H. P. Bybee, secretary; R. B. Whitehead, treasurer. Members of the council are: J. A. Udden, C. A. Hammill, E. W. Shuler, W. E. Wrather, J. G. Bartram and R. T. Hill. Sections of the society are now established at Austin, Texas; Ardmore, Oklahoma; Dallas, Texas; Lawton, Oklahoma; Okmulgee, Oklahoma; and Shreveport, Louisiana. The next general meeting will be held in the spring of 1922.

Dr. Colin G. Fink, of South Yonkers, who organized and for the past four years directed the research laboratories of the Chile Exploration Co., has resigned. Dr. Fink has been editor of the "Electrochemistry" section of *Chemical Abstracts* since 1907.

David B. Reger, assistant geologist of the West Virginia Geological Survey, will spend the present field season in Grant and Mineral Counties, making researches for a complete geological report on the area mentioned. Temporary headquarters will be at Piedmont.

The government of Panama has purchased a bronze bust of the late General William C. Gorgas, which will be placed at the entrance of the Santo Tomás Hospital at Panama. The *Journal* of the American Medical Association states that President Porras of Panama, in writing to the English sculptor in charge of the work, P. Bryant Baker, has stated, "We appreciate very deeply the sanitary work accomplished by Dr. Gorgas in Panama and feel this is one of the most appropriate ways of showing our gratitude."

William Brown Cogswell, the mining engineer, founder of the Solvay Process, died on June 7, aged eighty-seven years.

Two fellowship have been established by the honorary scientific society, Sigma Xi, which will pay a maximum of $1,800 each for the academic year, beginning in the fall of 1921. The funds for these fellowships have been contributed by the voluntary offerings of the members of the Sigma Xi scattered throughout the country, many of whom have agreed to contribute $2 a year for the purpose of encouraging graduate students to engage in scientific investigation. The fellowships are intended for those who have already received a doctor's degree. Applicants should present

their qualifications to Dean Edward Ellery, Union College, Schenectady, N. Y., before August 1.

AT the annual meeting of the American Association of Pathologists and Bacteriologists, held in Cleveland on March 24, it was voted to hold the next meeting in connection with the Triennial Congress of American Physicians and Surgeons in Washington, during May, 1922. The officers elected for the year were: *President,* Harry T. Marshall; *Vice-president,* Paul A. Lewis; *Secretary,* Howard T. Karsner; *Treasurer,* Frank B. Mallory. Other members of the Council are: Dr. Eugene L. Opie, Dr. Oskar Klotz, Dr. James Ewing, Dr. H. E. Robertson.

THE *Journal* of the American Medical Association states that an organization has been formed, the *Notgemeinschaft* for German science, which has been discussing ways and means to promote scientific research in Germany. The *Medizinische Klinik* quotes from the proceedings that, of the total 3,000 German scientific periodicals, 400 are to be continued with the aid of the organization. To make up for the lack of foreign publications during the war, a large sum will be appropriated to insure that all the important foreign journals will be represented in Germany at least by one or two copies of those published during the last few years, while the current numbers will be obtained by exchange. A purchasing and loan center for scientific material and instruments is to be installed at some central point to maintain the experimental research of the country on a higher limit. It is also planned to supply animals for experiments in medical and biologic research.

THE University of Michigan Biological Station will hold its thirteenth session for instruction and research on the shores of Douglas Lake, Cheboygan County, Michigan, from July 5 to August 26. Instruction in zoology will be given by Professors George R. La Rue and Paul S. Welch, University of Michigan; Frank Smith, University of Illinois; Zeno P. Metcalf, North Carolina State College of Agriculture and Engineering; and in botany by Professors Frank C. Gates, Kansas State Agricultural College; George E. Nichols, Yale University, and John H. Ehlers, University of Michigan. Mrs. Lois S. Ehlers, of Ann Arbor, is to be dean of women. Mr. Harry C. Fortner, University of Tennessee; Dr. Minna E. Jewell, Milwaukee-Downer College; and Miss Alice E. Keener will serve as assistants. Under certain conditions, properly qualified graduate students may complete the requirements for the M.A. or M.S. degree by working at the station through three or four summer sessions. Inquiries should be addressed to Professor George R. La Rue, director, University of Michigan, Ann Arbor, Michigan.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $300,000 has been made by the General Education Board to the million-dollar endowment fund of the University of the South.

DR. PHILLIP B. WOODWORTH, formerly dean of the engineering faculty at Lewis Institute and recently in charge of the educational work of the government as director of the Central District, has been elected president of the Rose Polytechnic Institute.

PROFESSOR HENRY P. TALBOT, professor of analytical chemistry and chairman of the faculty, has been appointed acting dean of the Massachusetts Institute of Technology.

As one step in the reconstruction plans of Yale University the subjects of pharmacology and experimental medicine have been combined as a university department with the title of department of pharmacology and toxicology, the chairman of which is Dr. Frank P. Underhill. The functions of the new department are three-fold: teaching, research and service to the community and state. Special attention will be devoted to the training of future investigators and teachers, and to the chemistry and physiology of the action of drugs and poisons.

AT the University of Pennsylvania, the fol-

lowing promotions have been made: Dr. C. B. Bazzoni to be professor of physics, Dr. George Gailey Chambers and Dr. Howard Hawks Mitchell to be professors of mathematics and Dr. Karl Greenwood Miller to be assistant professor of psychology.

DISCUSSION AND CORRESPONDENCE

THE GEOGRAPHICAL DISTRIBUTION OF HYBRIDS

It is often assumed by systematic botanists in this country that natural hybrids between species can only exist within the common range of the parent species. This opinion has been emphasized in a caustic criticism of Brainerd and Peitersen's recent article entitled "Blackberries of New England—their classification."[1] In the article cited,[2] the following expression appears:

> . . . no one, not specially forewarned or gifted with remarkable intuition, finding *Rubus frondisentis* ("*R. pergratus* × *setosus*") superabundant in Coos County, New Hampshire, *R. glandicaulis* ("*R. allegheniensis* × *sentosus*") in the thickets of Prince Edward Island, where *R. setosus* is unknown, or *R. arenicola* ("*R. Baileyanus* × *frondosus*") dominant on dry barrens of Nova Scotia where *R. Baileyanus* is unknown and where *R. frondosus* is represented only by *R. recurvans*, can guess in which key to trace his species.

A number of similar quotations might be cited from the same source all involving the negation of the possibility of the occurrence of a hybrid beyond the range of the parent species.

It would seem reasonable to appeal to the better known floras of Europe in a case of this kind, and no one can perhaps be quoted with more effect on this important subject than Anton Kerner von Marilaun. In the second volume of his classic "Pflanzenleben," as well as in the "Osterreichische botanische Zeitschrift" (Vol. 21 (1871)), this distinguished author has cited a large number of cases of natural hybrids.

Perhaps the most interesting example in this connection is the hybrid *Nuphar intermedium* which is a cross between *Nuphar luteum* and *Nuphar pumilum*, found distributed from the Black Forest and the Vosges northward into Russia and Lapland. In the southern part of its range, the hybrid is rarer and less fertile than it is further north. It is capable of extending its latitude northward of the range of both the parent species. Parallel cases are supplied by hybrids of *Epilobium, Brunella, Primula, Linaria, Rumex, Micomeria, Pulsatilla,* etc. In these various genera Kerner describes hybrids between wild species which often occur beyond the range of one or both of the parent species. Since the data supplied by Kerner on this subject can scarcely be questioned, it would appear that the absence of one or both of the parent species of a supposed hybrid in a given region is no valid argument against the hybrid origin of such an intermediate form. We have apparently still much to learn from our European colleagues both as regards accuracy and breadth of view in the matter of geographical distribution of hybrids. In the light of the above it does not appear necessary that the statements of Brainerd in regard to probable natural hybrids of *Rubus* should be accorded less credence and respect than have been given to his classic results in the case of natural hybrids in the genus *Viola.*

E. C. Jeffrey

Harvard University

[1] Vermont Agricultural Experiment Station, Bulletin 217, Burlington, Vermont.

[2] *Rhodora,* Vol. 22, pp. 185–191.

STAR DIAMETERS

To the Editor of Science: Referring to the communication of Professor Fessenden concerning star diameters (Science, March 25, 1921, page 287–8), allow me to say that it does not seem possible that the measured diameter of Betelgeuse is affected by a gravitational displacement. In the first place, there are stars, of solar type for example, in connection with which the conditions would seem to be far more favorable for such a displacement and yet these objects show no appreciable disk. Further, we know that light reacts to a gravitational field in such a manner that there is no permanent acceleration in the direction of propagation. This fact reduces the possibility of a displacement to a

rotation of the plane of the wave front, which would not increase the apparent diameter of a star.

In the case of either an orbital displacement or a rotation of the wave front, the observed deflection decreases with the distance and would be inappreciable at stellar distances. It can be shown that the sun at the distance of the nearest star would show a displacement at the limb, on the Einstein hypothesis, amounting to less than one millionth of a second of arc, if the deflected beam originated in a neighboring companion.

Keivin Burns

Allegheny Observatory

RUSSIAN SCIENTIFIC MEN

To the Editor of Science: Attention has been called in Science to the British "appointments committee for Russian scientific and literary men," under the chairmanship of Sir Arthur Schuster. Many Russians distinguished in various branches of learning are at present scattered over European countries, some of whom are destitute, while others are earning a precarious livelihood by work in which they have no opportunity of exercising their particular capabilities, the world at large thus losing the benefit of their knowledge and aptitude.

The object of the committee is to bring the names and qualifications of some of these men to the notice of universities and other institutions outside of Russia which may be able to offer them suitable employment. Lists of these names have been sent by the committee to various universities and organizations and the National Research Council has just arranged to send similar lists to the presidents of about two hundred colleges and universities in this country.

The council has also received a circular letter from a committee of meteorologists and geophysicists of Vienna which asks if certain kinds of statistical and preparative work needed by meteorologists and geophysicists of this country can not be done, for pay, in Vienna. These meteorologists and geophysicists have access to many valuable sources of statistics and general data and appeal for opportunity to do this work in order to assist in supporting themselves. Any communications which it may be desired to make to this committee should be addressed to Dr. A. Wagner, Zentralanstalt für Meteorologie, Hohe Warte 38, Vienna XIX.

Vernon Kellogg

National Research Council

May 27, 1921

SPECIAL ARTICLES

A CONVENIENT CULTURE MEDIUM FOR DAPHNIDS

Daphnia and other Cladocera may be fed upon certain unicellular green algæ, a mixture of various protozoa and protophyta obtained from the sediment of ponds in which there is a considerable quantity of organic matter, or upon bacteria.

For more than five years the writer successfully utilized material from ponds in obtaining food for Cladocera cultures representing several species. The somewhat discolored water was dipped up in such a manner as to obtain considerable amounts of the loose fluffy sediment lightly resting upon the bottom. In the strainings which followed (through silk bolting-cloth, to prevent contamination of the laboratory stock) much of this sediment was rubbed through the straining cloth and distributed with the water to the culture bottles (about 100 c.c. in quantity in ordinary wide mouthed 200 c.c. bottles). This method of obtaining culture water containing the proper food organisms has certain limitations. The water and sediment from most ponds do not constitute a proper culture medium; a pond from which a good culture medium may be obtained is hard to find. Further from month to month and season to season such a pond undergoes wide fluctuation in its usefulness as a source of daphnid food; it may even dry up and one's Cladocera material be imperilled or lost.

Some workers using algæ have cultivated them in jars of water; others on agar plates. The necessity for obtaining just the proper sorts of algæ and the requisite skill in their

cultivation make this method of obtaining proper food for Cladocera perhaps less useful in some cases than the one now to be described.

It seemed desirable to have a culture medium which could be readily obtained anywhere and at any season of the year. Such a medium has been obtained as follows: two pounds of fine garden soil are placed in a large battery jar (9 in. diameter); to this are added six ounces of finely divided fresh (8 to 15 days old) horse manure and the whole is covered with 10 quarts of strained pond water. Pond water is specified because Cladocera are extremely susceptible to the toxic effects of the salts of the heavy metals. Tap water should be used with caution until proved innocuous. The mixture is allowed to stand at 15° to 20° C. without disturbance for three days when it is strained through silk bolting-cloth. The proper straining is facilitated by carefully dipping out and straining most of the supernatant liquid and then agitating the remainder and with it rubbing a very small portion of the soil through the straining cloth. The solution is then ready for use, though in addition to being thoroughly stirred before being placed in the culture bottles it is usually diluted by adding pond water in the proportions of from 1 to 4 to 1 to 2, depending upon the degree of density in the appearance of the solution.

This culture medium has proved extremely useful to the writer and is now used exclusively for all his Cladocera cultures. No renewal of the solution in a culture bottle is ordinarily required during the life of an individual Cladoceran. Not every make-up of food proves equally satisfactory but persons unaccustomed to handling such culture water quickly learn the proper handling and dilution and very soon obtain excellent results. This soil-manure solution is equally practicable for rearing copepods and some, at least, of the rotifers.

Bacteria constitute the principal food element in this culture medium. While a certain amount of uniformity is attainable in such a culture medium, such mass cultures are quite variable and it is obvious that this can scarcely be considered a "standard" food. It is probable that the proper bacteria could be reared on agar plates, definite quantities introduced into the culture bottles at definite intervals and a really standard food thus obtained.

Arthur M. Banta

Station for Experimental Evolution

THE NEBRASKA ACADEMY OF SCIENCE

The thirty-first meeting of the Nebraska Academy of Science, held in Bessey Hall, University of Nebraska, Lincoln, on April 1 and 2, was one of the most interesting in the history of the organization. The attendance was about one hundred, comprising many educational institutions of the state and one or two from adjoining states. The program was so full it was divided into three sections. A very pleasant feature was the annual dinner held in Ellen Smith Hall, followed by President Walker's address, and a general discussion of the needs and interests of the Academy. Dr. Walker made a number of recommendations and suggestions for the advancement of the organization, which has suffered in the past from a lack of the interest and enthusiasm which usually mark the annual meetings. The harvest time of the organization is between the annual meetings, if the officials are sufficiently active and progressive.

At the business session on Saturday morning a number of new members and the following officials for the coming year were selected: *President*, J. C. Jensen, Nebraska Wesleyan University; *Vice-president*, H. O. Sutton, Teachers' College, Kearney; *Secretary*, Rose Clark, Teachers' College, Peru; and *Treasurer*, P. K. Slaymaker, University of Nebraska. A number of amendments to the constitution were approved and the offer of Dr. Sheldon, of temporary headquarters for the academy with the Legislative Bureau, was accepted. University Place was chosen for the 1922 meeting.

W. F. Hoyt,

Secretary

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THE CORAL REEFS OF TUTUILA, SAMOA

The preparation of a detailed chart—not yet published—of Tutuila, Samoa, by the U. S. Hydrographic Office, and the studies made by various scientific specialists invited to the island by Dr. A. G. Mayor, director of the department of marine biology of the Carnegie Institution of Washington, have added greatly to the knowledge of that remote possession of ours in recent years. The chart, on a scale of about 1 : 50,000, shows the mountainous volcanic island to be surrounded by an extensive submarine bank, from one to three miles wide, somewhat shallower near its inner and outer margins than along an intermediate belt, where soundings of 60 fathoms occur. The shallower parts of the bank are interpreted as submerged fringing and barrier reefs, which are supposed to rest on a wave-cut platform now lying between 60 and 70 fathoms below sea level by reason of island subsidence. The present shores of the island are embayed and are bordered by well developed fringing reefs.

Dr. Mayor's latest Carnegie report contains a condensed statement by R. T. Chamberlin, entitled "The geological interpretation of the coral reefs of Tutuila, Samoa," the result of three weeks' observation there in July, 1920, from which the following extracts are taken:

> The island of Tutuila is a volcanic pile whose slopes have been attacked by the sea until a broad wave-cut platform, 2 miles in width, has come to surround the island. This broad shelf of planation, originally cut in the volcanic rocks not far below the sea level, now lies at least (though probably not much more than) 400 feet below sea-level. . . . On the outer margin of the wave-cut platform, corals commenced to build a barrier reef, while a fringing reef grew outward from the shore. . . . Subsequently the island became progressively submerged. . . . Tutuila, therefore,

is consistent with the Darwin-Dana coral-reef hypothesis to the extent that a submergence of 400 feet has occurred since the corals began to form the old barrier reef; but in other respects it does not fit the requirements of that hypothesis, inasmuch as the barrier reef, instead of being built up several thousand feet from the slopes of a sinking island, is found to be rooted on a broad, wave-cut platform.

Dr. Mayor comments on Chamberlin's statement in part as follows:

Professor R. T. Chamberlin, who made a special study of the relation between the reefs and the volcanic shores of the island, . . . finds that the ancient barrier and fringing reefs which once surrounded the island and are now drowned grew upon a platform which had been cut by the sea and afterwards submerged and not upon the unaltered slopes of the island. Thus the Darwin-Dana theory does not apply to Tutuila.

Chamberlin's summary concerning the origin of the reefs is excellent as far as it goes, and it is to be presumed that if he publishes a fuller account of his results he will then supplement the present brief statement with an explanation of the conditions which determined that Tutuila should be for a time reef-free and therefore exposed to abrasion before it became reef-encircled, and with a description of the high cliffs that must have risen at the back of the now submerged 2-mile platform and of their relation to the recently cut cliffs the base of which is close to actual sea level.

But excellent as the present summary is with respect to the reefs of Tutuila, neither the passage above quoted from it nor the passage quoted from Mayor's comment upon it does justice to Darwin's theory of coral reefs; for in so far as the quoted passages imply that the submerged barrier reef of Tutuila does not exemplify the "Darwin-Dana" theory, they hold good only for an imperfect, indeed an incorrect conception of that theory. As a matter of fact the Tutuila reefs, both submerged and at present sea level, exemplify certain special phases of Darwin's theory in a remarkable manner, as the following citations from his "Structure and Origin of Coral Reefs" (1842) will make clear.

In the first place, Darwin nowhere asserted that barrier reefs must be "built up several thousand feet from the slopes of a sinking island," or that they could not be built up from a "broad, wave-cut platform," as Chamberlin implies, or that they must grow up from "the unaltered slopes of an island," as Mayor assumes. All that Darwin's theory of barrier reefs and atolls demands is that a foundation of any form shall subside slowly enough for the reef to grow upward and maintain its surface at sea level. The form of the foundation is immaterial. It is true that the typical island profile which Darwin drew in two figures (pp. 98, 100), to represent a subsiding foundation on which a fringing reef would be transformed into a barrier reef and a barrier reef into an atoll, showed an island of a particular form, as graphic illustrations always must; but as this profile was modeled upon that of the island of Bolabola, a deeply denuded member of the Society group, it effectually disposes of Mayor's assumption that Darwin thought reefs grew up from "the unaltered slopes of an island."

It is true that Darwin nowhere wrote anything about the denudation of Bolabola, but he was perfectly familiar with the fact that the slopes of volcanic islands are altered by erosion and abrasion. His geological philosophy was somewhat primitive, for he thought that many volcanic islands had been uplifted after their conical form had been produced by eruption, and that during the resulting emergence the sea cut valleys in the island slopes; it was, indeed, by this process that he accounted for the repeated breaching of certain original "basaltic rings," composed of outward dipping lava beds, and their conversion into a circuit of separated hills, such as characterize the islands of "St. Jago" in the Cape Verde group, St. Helena, and Mauritius. He also knew that "deep arms of the sea . . . penetrate nearly to the heart of some [reef] encircled islands," Raiatea in the Society group being mentioned as one of them; and the depressions occupied by such sea arms were surely understood

to be alterations from the original form of the islands. Hence there is no warrant whatever for thinking that Darwin's theory demands the growth of reefs on unaltered volcanic slopes.

The particular kind of alteration caused by the abrasion of circum-insular platforms was very properly not shown in his type diagram, because, so far as Darwin's observation and reading went, no barrier reefs were known to have grown up from foundations of that kind. He knew full well, however, that platforms might be abraded and that reefs might grow upon them; but he believed that, unless subsidence occurred, such reefs would differ from ordinary barrier reefs in having shallow lagoons behind them, as will be shown below.

Various passages in his book make it clear enough that no particular form of reef foundation was regarded as essential. Anything on which a reef might begin its growth would suffice. For example, Darwin wrote: "If the rim of a [non-subsiding] crater afforded a basis at the proper depth, I am far from denying that a reef like a perfectly characterized atoll might not be formed; some such, perhaps, exist; but I can not believe in the possibility of the greater number having thus originated" (89). And again: "A bank either of rock or of hardened sediment, level with the surface of the sea, and fringed with living coral, would . . . by subsidence be converted immediately into an atoll, without passing, as in the case of a reef fringing the shore of an island, through the intermediate form of a barrier reef" (101). Evidently, the prime element in Darwin's theory of barrier reefs and atolls was subsidence; no particular form of the foundation on which reef growth begins was assumed, except for purposes of graphic illustration. Such illustration always involves definite profiles; but the more general statements of the text show that definite profiles are not required.

Moreover, a careful reading of Darwin's book will discover that he clearly conceived the possibility of a reef growing up from the outer margin of an abraded platform, as now appears to have been actually the case on Tutuila; and that he gave this possibility little consideration, not because such a reef would not grow upward into a true barrier if the platform subsided, but only because he found no examples of it. He wrote:

> It will, perhaps, occur to some, that the actual reefs formed of coral are not of great thickness, but that before their first growth, the coasts of these encircled [non-subsiding] islands were deeply eaten into, and a broad but shallow submarine ledge thus left, on the edge of which the coral grew; but if this had been the case, the shore would have been invariably bounded by lofty cliffs, and not have sloped down to the lagoon channel, as it does in many instances (49).

Certain volcanic islands that Darwin had seen in the Atlantic, before he was concerned with the origin of coral reefs, had made him familiar with the visible occurrence of sea-cut cliffs; and the "broad but shallow submarine ledge" that must extend forward from the base of the cliffs was apparently familiar by inference. Thus he described St. Helena as surrounded by "enormous cliffs, in many parts between 1,000 and 2,000 feet in height," and added that "the swell of the Atlantic ocean has obviously been the active power in forming these cliffs." In various other reef-free islands he recognized "the prodigious amount of degradation, by the slow action of the sea, which their originally sloping coasts must have suffered, when they are worn back, as is so often the case, into grand precipices."[2] He does not explicitly announce the contrast between the "grand precipices" of volcanic islands that are not defended by encircling reefs, and the moderate slopes that lead "down to the lagoon channel" in nearly all reef-encircled islands; but he knew and correctly described both classes of islands.

In view of all this it is manifest enough that, if Darwin had at hand the facts now known about Tutuila, he would have said, in effect:

> Tutuila is an actual island which must formerly have been "deeply eaten into" by the sea, and which must then have been surrounded by a "broad but shallow submarine ledge" backed by

[2] "Geological Observations," 1844, 91, 128.

"lofty cliffs"; yet the very fact that most other barrier reef islands are not "bounded by lofty cliffs" but "slope down to the lagoon channel" shows that they have not been "deeply eaten into"; or if they have been then the resulting cliffs have been completely submerged by later subsidence.

His general scheme of upgrowing reefs on subsiding foundations therefore takes in without any difficulty the special case of an island around which a platform had been abraded.

Good reasons may be given for believing that the peculiar case of completely submerged platform-back cliffs, just alluded to, is a very probable one; for wave-cut platforms and cliffs presumably occur as normal features in an early, pre-reef stage of young volcanic islands; and their rarity to-day is best explained by the strong subsidence of the islands since the platforms were cut; but the discussion of this question would lead away from the matter here under consideration.

Another passage from Darwin's book, directly following the one above quoted about the possibility of reefs growing on the coast of an island that has been deeply eaten into by the sea, is pertinent here, as it explicitly considers the growth of a reef upon a platform margin and the depth of the resulting lagoon:

> On this view,[3] moreover, the cause of a reef springing up at such a great distance from the [non-subsiding] land, leaving a deep and broad moat within, remains altogether unexplained.

Or otherwise phrased: If a reef sprang up from the outer margin of a broad platform, cut by waves around a still-standing island, the enclosed lagoon could not be so broad and deep as barrier-reef lagoons usually are, unless subsidence had occurred along with reef growth. The quoted statement is not so clear as Darwin's writing generally is, but the modified phrasing here suggested is believed to represent his fuller meaning; it is certainly consistent with the context. In any case, Darwin clearly knew that a platform could be abraded around a volcanic island and that such a platform must be backed by cliffs; and he further believed that, if a reef grew up on the margin of the platform, the lagoon thus enclosed would not have the depth of most barrier-reef lagoons; but that if the abraded island subsided and the reef grew higher, the depth that is usually found in barrier-reef lagoons would thereupon be produced. According to the present understanding of the coral-reef problem, it is precisely the occurrence of such subsidence that puts a stop to further abrasion by making reef-growth on a platform margin possible; but Darwin did not detect this point, nor did he see that the opportunity for abrasion of platforms around volcanic islands in the coral seas is best provided, as above mentioned, when the islands are young and high, with simple, non-embayed margins, so that a large amount of detritus shall be washed down from their steep slopes to the shore, where its accumulation in beaches inhibits coral growth and permits abrasion. Indeed, this explanation of the condition under which the abrasion of a platform may occur is not mentioned even in Chamberlin's summary, though its omission there may be due rather to the conciseness of the summary than to a rejection of the explanation. The explanation has, however, a considerable theoretical importance in giving reasonable consideration to an early pre-reef stage of island development that has been generally overlooked;[4] and it was in view of this explanation that the common occurrence of completely submerged platform-back cliffs was above suggested as probable in barrier-reef islands; but the platforms associated with these submerged cliffs need not have been nearly so broad as the submerged platform of Tutuila.

It may be added that the opportunity for platform and cliff cutting on Tutuila can not be advisedly ascribed to the inhibition of coral growth by the lowered temperature of the lowered Glacial ocean, as is postulated

[3] A footnote in Darwin's book at this point reads: "The Rev. D. Tyerman and Mr. Bennett . . . have briefly suggested this explanation of the origin of the encircling reefs of the Society islands."

[4] "Clift Islands in the Coral Seas," *Proc. Nat. Acad Sci.*, II., 1916, 283–288.

in the Glacial-control theory of coral reefs; for if the Tutuila platform had been cut to a width of a mile or two in volcanic rock under such conditions, similar platforms should have been cut around other volcanic islands, and the tops of the platform-back cliffs should be visible to-day above normal sea level; but as a matter of fact such partly submerged cliffs, or plunging cliffs as they may be called, have not been often detected; besides Tutuila, the other best known examples are Tahiti and the Marquesas islands, as will be further told below.

To return to Darwin's text: a further examination of it discovers a remarkably close parallel to the actual condition of Tutuila, as the following statement will show. The Tutuila barrier reef is now drowned; its successor is a fringing reef on the marginal slopes of the abraded island; and these slopes are, according to Mayor, steeper than the sides of the valleys by which the island is dissected. Now in view of the association of fringing reefs with rising or stationary coasts in Darwin's theory—as it is ordinarily quoted—it might be thought that the occurrence of the Tutuila fringing reef around a subsided island contradicted his views. But that such is not the case is made clear by this prophetic sentence:

> If during the prolonged subsidence of a shore . . . an old barrier reef were destroyed and submerged, and new reefs became attached to the land, these would necessarily at first belong to the fringing class (124).

That is precisely the case at Tutuila. Evidently, it is immaterial whether the "old barrier reef" here mentioned had been formed by upgrowth from the slopes of a non-abraded, subsiding island, or by upgrowth from the margin of a platform on an island that subsided after the plaform had been abraded. Darwin's suggested explanation is excellent; it was only because he found no examples of fringing reefs thus produced that he did not pursue the suggestion further; but fringing reefs of this kind abound in the Philippine Islands.[6]

If it be true that the submerged barrier reef of Tutuila was formed on a subsiding platform of marine abrasion, one or two miles in width, the cliffs at the back of the platform should have been 1,000 feet or more in height. Hence the upper part of their faces ought still to be visible after a subsidence of some 400 feet; and it should therefore be on the now submerged part of the cliff faces that the present fringing reefs of Tutuila have been formed. Mayor's accounts of Tutuila tell, however, of narrow platforms backed by steep cliffs a few hundred feet in height that have been cut close to present sea level since the submergence of the barrier-reef platform. It would therefore seem that these new cliffs must have been cut in the slanting faces of the earlier and greater cliffs after their partial submergence. This relation of the two sets of cliffs has not been mentioned, as far as I have learned, by any observer on Tutuila; it is a "flier" of my own,[7] based on the dimensions of the new cliffs and platforms as reported by Mayor. The relation of the height of these cliffs to the breadth of the platforms at their base suggests that the inclination of the preexisting spur-end surfaces in which the new cliffs have been cut was much steeper than the ordinary radial slope of the spurs on a dissected volcanic island, but not steeper than the precipitous descent which the earlier-cut, spur-end sea cliffs might have had at the back of their two- or three-mile platform; and as the cliffs at the back of so wide a platform must have had some such height as 1,000 feet, the upper part of their slanting faces should be still visible as plunging cliffs after a 400-foot subsidence. Furthermore, the idea that the new cliffs of Tutuila are cut in the earlier ones gains some support from photographs of Tutuila by Mayor, and from photographs of the Marquesas islands by Iddings; for these islands appear to resemble Tutuila in many respects, although their submerged platforms, the presence of which is indicated by a few soundings in front of their plunging cliffs, are

6 "The fringing reefs of the Philippine Islands," *Proc. Nat. Acad. Sci.*, IV., 1918, 197–204.

7 "The islands and coral reefs of Fiji," *Geogr. Journal*, IV., 1920; see p. 218.

not yet well enough known to warrant any statement as to whether they bear submerged reefs or not; and although new sea-level fringing reefs are not yet developed on the Marquesas cliffs, for Mayor reports the growth there of only separate corals on the cliff faces below sea level. A corollary of this last-mentioned fact is that the submergence of these islands must be more recent than that of Tutuila.

Had the old barrier reef of Tutuila not been drowned by a too rapid submergence—possibly the result of subsidence at an ordinary rate reenforced by the Postglacial rise of ocean level—it would have to-day formed a sea-level barrier reef enclosing a fine lagoon; and it would have thus imitated the barrier reef which surrounds Tahiti, where the island spurs are strongly cut off in plunging cliffs between embayed and mostly delta-filled valley mouths, thus indicating that the visible barrier reef of Tahiti, like the submerged barrier reef of Tutuila, has grown up from an abraded, cliff-backed platform. It may be parenthetically added that the form of the larger valleys of Tahiti, now embayed and delta-filled, suggests some such measure as 600 or 800 feet for the submergence of the inferred cliff-base platform; also, as the Tahiti reef now reaches sea level and as most of the drowned-valley embayments there are filled with deltas, that island must have been submerged less rapidly and less recently than Tutuila. And to this it may be added that the submergence of Tutuila must, as already noted, have been less recent, but perhaps not more rapid than that of the Marquesas, where not even fringing reefs are yet formed; and finally that local subsidence of these different islands, varying in rate and in amount from place to place, and not a synchronous and uniform rise of the ocean, must be taken as the cause of their non-synchronous and non-uniform submergences.

But if this view concerning barrier reefs be correct, it might be objected that neither the submerged barrier reef of Tutuila nor the sea-level barrier reef of Tahiti was formed according to Darwin's theory, because according to that theory—as it is usually quoted—barrier reefs are supposed to have developed from on-shore fringing reefs, while the Tutuila and Tahiti barrier reefs appear to have developed from off-shore, platform-margin reefs. Yet even this contingency is provided for in Darwin's wonderfully well reasoned discussion, as may now be briefly pointed out.

It is true that Darwin's type figure represents the initial stage of reef growth as an on-shore fringe around a rather steeply sloping island border; and that the fringe is transformed, as subsidence progresses, first into a barrier reef and later into an atoll; and from this it has been generally inferred that, when Darwin described barrier reefs and atolls as developed from fringing reefs, on-shore fringes must have been meant. But a closer examination of his text leads to a different conclusion. His chapter on fringing reefs defines them in a manner that appears to have been generally overlooked. He included in that chapter not only reefs closely attached to the shore of their islands, but also other reefs "not closely attached." Several off-shore reefs on the shelving sea floor of Mauritius and off the east coast of Africa are there presented as examples of detached fringing reefs:

> On the western side of Mauritius . . . the reef generally lies at the distance of about half a mile from the shore; but in some parts it is distant from one to two, and even three miles (52).

Again, on the eastern coast of Africa,

> For a space of nearly forty miles, from lat. 1° 15′ to 1° 45′ S., a reef fringes the shore at an average distance of rather more than a mile, and therefore at a greater distance than is usual in reefs of this class. . . . In the plan [small chart] of Mombas (lat. 4° S.) a reef extends for thirty-six miles, at the distance of from half a mile to one mile and a quarter from the shore (56).

None of these off-shore reefs has "an interior deep-water channel," but only a shallow one. It is therefore by the absence of a deep lagoon and in spite of the detachment of these reefs from the shore that they are, in Darwin's terminology, classed as fringing reefs and distinguished from barrier

reefs. Whether modern observers will adopt his terminology in this respect or not is aside from the point here at issue. The fringing reefs which Darwin regarded as the early stage of barrier reefs may have been either on-shore reefs or off-shore reefs; but if off-shore, the belt of water between them and the land must have been shallow. This is made perfectly clear by his explicit statement:

> Fringing reefs on steep coasts are frequently not more than from 50 to 100 yards in width; they have a nearly smooth, hard, surface, scarcely uncovered at low-water, and without any interior shoal channel, like that within those fringing reefs which lie at a greater distance from the land (55, 56).

These citations leave no doubt that, when the now-submerged barrier reef of Tutuila was first formed at a distance of a mile or two from the cliffed inner border of its shallow supporting platform, it would have been classed by Darwin as a fringing reef, because the "enclosed water channel" was then of small depth. But when subsidence continued and permitted reef upgrowth to such a height that the enclosed water channel or lagoon was increased in depth, then Darwin would have called it a barrier reef, as modern observers are united in doing.

The principle here involved is, however, of no great importance, because it was not Darwin but his successors who have emphasized the supposedly necessary sequence of fringing reef, barrier reef, and atoll, as a consequence of the theory of subsidence. Darwin's own discussion recognized this succession as characterizing the typical example of a subsiding island, like Bolabola; but he explicitly recognized other sequences in less typical cases. If the original reef foundation had been a bank close to sea level, the initial fringe would have become an atoll, as subsidence progressed, "without passing . . . through the intermediate form of a barrier reef," as a quotation (101) already made shows clearly enough. Or if a reef grew up from the rim of a still-standing submarine crater of proper depth, a possibility which Darwin explicitly recognized (89), an atoll would be formed without the preliminary formation of a fringing or a barrier reef. The point of all this is that Darwin conceived many conditions under which coral reefs might be established and transformed, and did not restrict himself to a special form of reef-foundation or a fixed sequence of reef development, even though he understood that the most probable explanation of the majority of barrier reefs is by the more or less intermittent upgrowth of fringing reefs from subsiding foundations, and that the best explanation of most atolls is by similar upgrowth from subsiding barrier reefs.

The object of this article is to point out that the full meaning of Darwin's broad discussion can not be condensed into a rigidly conceived theory, beginning with an island of a certain shape and proceeding through a perfectly definite sequence of transforming reefs. His treatment of the problem was far broader than that, as the citations given above must suggest, and as various other citations would confirm. Far from being inconsistent with his broadly conceived theoretical discussion, the reefs of Tutuila as described by Mayor, Chamberlin and others are remarkably close exemplifications of some of its most significant special phases.

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A NOVEL MAGNETO-OPTICAL EFFECT

EARLY in April, 1921, while my son, Malcolm Thomson, was operating, in a building of the River Works plant of the General Electric Co., a resistance welder for closing the seams of steel Langmuir mercury vacuum pumps, in which work the current is applied and cut off at about one half second intervals, there was noticed by one of the working force, Mr. Davis, who happened to be favorably located, a peculiar intermittent illumination of the space near the welder as the current went on and off. My son at once placed himself in a similar position and saw the novel effect, and noted a number of conditions accompanying it, perhaps the most important being that a single turn loop from the welding transformer to

the work and back was carrying about 7,000 ampères, and that the luminous effect was spread in the space in which would be located the magnetic field from this loop; that the sunlight was entering the building through high windows and shining across the space in which the field was produced at intervals; that the effect was most conspicuous when one looked towards the shadows, and across the sunbeams, and also across the magnetic field.

This would be expressed by saying that the best effect was observed when the line of vision was downward at an angle intersecting the entering sunbeams, and into the shadows under the beam furnished fortunately by a partition a few feet high, over which the sunlight came. The magnetic field, neglecting the curvature of the lines, was, generally speaking, at right angles to the line of sight and to the direction of the sunlight. My son also noticed that the effect of increased luminosity was coincident with the putting on of the current and disappeared at once on cutting off the field. It was thus clear that it depended on the establishment of the magnetic field. He reported these facts to me and they were confirmed by me. Other observers were soon enlisted, and on several favorable sunny days all the above observations were confirmed by them. Further, my son had not been able to see any effect when looking across the sunbeam from the opposite side. This means that with the sunbeams streaming in from the south, the effect was observed looking southward and downward; the windows admitting the light being to the south. Looking from the south across the beam gave no result, though it was not possible to look directly across the beam on a slant upward into any dark shadows and at the same time have the line of vision cross the magnetic field.

It is interesting to note at this point that the luminosity filled the whole space and extended as far away as four feet or more from the magnetic loop, and that it was not especially noted as more intense near the loop than at a distance therefrom of say two feet or more.

Mr. Malcolm Thomson had further observed that by cutting out the loop from the secondary terminals (clamps) of the welding transformer and simply joining those terminals by an iron bar, as is done in resistance welding, the luminous effect in the neighborhood of the transformer was still visible, but was much more feeble than when the heavy loop was used. It occurred to me to examine the light by a large Nicol's prism. It was found that there was a distinct polarization of the light from the space. This means that when the magnetic field was on, the sunlight was scattered in the direction of the observer, from the space occupied by the sunlight beam and the magnetic field, and that such scattered or deflected light was polarized.

It occurred to me, as a possible factor in the case, that as the building was used in part to carry on arc welding by iron arcs, there might be suspended in the air of the building iron particles or finely divided oxides or compounds of iron, which in some way were oriented by the magnetic field, resulting in the scattered light noted. This was confirmed in part by making the test observations when the large doors of the building had been open for some hours. The effect was present though difficult to detect. This led to the suggestion to bring an iron arc into operation near the space in which the luminous effect had been seen. This was done and with an enhancement of the effect.

At this stage, the further observations were carried on in the Thomson Laboratory at Lynn, Mass., with the aid of the laboratory corps (A. L. Ellis, H. L. Watson, Dr. Hohlnagel, and others).

Two sets of test apparatus were prepared at my suggestion. One large welding transformer was mounted in a special room, into which the sunbeams could be received in the afternoon, as the windows faced south by west. The secondary terminals were joined by a large loop of heavy copper cable about 12 square centimeters section and of a loop diameter of .6 meter. The loop consisted of two turns. The plane of the loop was vertical and was nearly north and south, or in a plane parallel to the direction of the entering sun-

beams, so that the magnetic field would be in the main horizontal and transverse to the light of the sun entering downward as before. An iron arc was arranged to be operated so that the smoke from it would rise from below and enter the field of the loop, and by changing the relative position of the arc, the smoke column, widening as it rose, could be made to bathe the turns of the coil, cross its axis, or at a distance away, merely enter the field. As the experiments thus far had always involved connection to the shop plant, with 60 cycle A. C. current, a check apparatus was set up, consisting of a storage battery (of a type such as is used in automobile starting) arranged on a stand. In circuit with it, and under control of a switch was a coil of about .2 meter diameter and giving a field due to about 2,500 ampère turns when the switch was closed. This second apparatus could be moved about and was entirely independent of supply circuits, or static dusturbances which might be present in them.

The first tests were made with the transformer loop (representing a field of 20,000 ampère turns) and were very striking. The rising smoke from the small iron arc, only moderately visible in the sunbeam, became decidedly luminous when the field was put on. Each closure of the current switch to the primary of the transformer was instantly followed by the brilliant smoke effect, and the effect instantly disappeared on the opening. A black background had been provided in front of which the smoke rose. After the arc had been running a few minutes only, it was seen that the air of the room was carrying sufficient of the smoke particles to give the effect anywhere in the space covered by the magnetic field and the sunbeams, even a number of feet away from the coil. In this case the appearance was as if in the air there were diffused some substance or material which only became visible in the combined sunlight and magnetic field. That in this case the luminous effect is not greater near the coil loop than feet away, indicates that orientation, or whatever causes the effect, is complete even in a rather weak field. Thorough ventilation of the room by opening windows, caused the effect to fade out gradually by removal of the active particles.

The experiments with the D.C. current coil and battery conclusively showed that the effect was present with it, as with alternating current, and incidentally established the fact that the effect on the particles is independent of the direction of magnetization. It is doubtful if high frquency tests would allow us to discover whether the establishment of the effect requires time. Probably not. Observations made through the axis of the loop of two turns show a minimum of effect, from which it may be inferred that it is not present if the viewing is exactly along the field line direction.

Polarization.—Having obtained, as described in the foregoing, a controllable and relatively brilliant source of the luminosity, tests with the Nicol's prism were resumed. It was soon noted that the polarization was decided as controlled by the magnetic field. Moreover, the very curious fact was discovered by me that the fumes from the iron arc were composite so far as analysis by the polarizing prism was concerned. The bluish colored smoke arising gave but little effect, but there was with it a yellowish gray fume, which was highly luminous in one position of viewing by the prism and invisible when the prism was at right angles to that position. This indicates complete polarization when the field is on, for the light diffused from the particles in the yellowish gray fumes. This is an extraordinary effect, for which no evident explanation suggests itself, for the field lines are not straight but wrap themselves around the coil or loop in curved directions, and the effect is apparently complete even with the fumes rising in the space where the lines are strongly curved.

It remains to use a vertical beam of light and make tests from opposite directions across the field, also to use artificial light instead of sunlight. The design of a small demonstration apparatus seems possible, consisting of a coil to be put on a battery or lighting circuit, A.C. or D.C., a small iron arc between two wires, a box with darkened interior to be filled with

fumes, having two sides of glass, one for the admission of the light beam and the other a window at right angles for observation. Two coils placed outside the box space and opposite each other, or capable of application in different relations will have advantages. The addition of eye shields to cut out extraneous light and a tortuous chimney conveying the smoke but cutting off the light from the iron arc are desirable additions to the equipment, as also an analyzer as part of the apparatus for the polarization effect.

The Microscope.—Attempts have been made to catch the particles in the smoke from the arc upon a glass slide for microscopic examination as to their form under high powers. That they are exceedingly fine is evident from their remaining in suspension so long in the air and diffusing themselves rapidly throughout the air. That an exceedingly small amount of material suffices for making the whole air of a large room capable of showing the effect is evident also. The sunbeam may enter the room and its course is not disclosed by them unless the magnetic field exists. It seems natural to suppose that the particles consist of some form of iron or iron oxide, but without proof this can not be fully decided. Other particles might exist giving such an effect, but it must be confessed this does not seem probable. Other fumes and smokes from arcs so far have given no results. The smoke from a nickel arc does not give the effect. Neither does a cobalt arc yield fumes behaving like iron smoke.

The fumes and smoke of an iron arc were caught on a clean microscope slide until a patch of sediment of a slightly yellowish brown tint, but very pale, was deposited. Under moderate powers, very little of any definiteness is shown, but under the high power of an oil immersion lens of about 1.5 mm. focal length, there is disclosed a curious structure of particles seemingly between .0002 and .0001 mm. diameter, which particles are frequently strung together, 4, 5, 6, or more, in a line, giving the effect of a short piece of chain made of small roundish particles, slightly spaced apart, or of a short section of a string of beads (round beads) not touching one another. Many of these structures appear to be straight, and some are curved. Evidently in a magnetic field these chains of particles, presumably of oxide of iron, and magnetic, would line up and reflect or diffuse light of the sun striking them. If the direction of vision was such as to favor polarization of the rays in a direction nearly at right angles to the incidence of the solar beam, the polariscope effect would be accounted for, measurably. Aside from polarization, the lining up of the chains would also account for the extra *visibility* of the smoke under the conditions of the experiment.

It would seem from the foregoing that a considerable length of column of smoke from the iron arc, and subjected transversely to a magnetic field, might be expected to act as a means for obtaining polarized light in the direction of the beam itself. This assumes that there will be a considerable scattering of light polarized as above described in a direction sidewise, leaving the light which passes through polarized in a plane at right angles. The apparatus might be compared in its action to a Nicol's prism, transmitting rays in one plane and throwing out laterally those in the other plane. This suggestion will be tested as soon as proper arrangements can be made.

The polarized light which is sent out from the smoke particles in a direction transverse to the sunlight beams, when the magnetic field is put on, is in the same plane as that reflected from a sheet of glass at the polarizing angle receiving the same beam. This fact is in accordance with what might be expected if the short sections of chain or beaded particles were oriented or lined up by the magnetic field; the transverse waves of light vibrating in a plane intersecting the length of the chains would not be deflected on account of the extremely small diameter of the particles composing them, but waves vibrating in the plane of the length of the chains would be reflected to the side and this would account for their plane of polarization being what it is. Such waves would behave as if reflected

from short rods in line with the plane of vibration, while the extremely small diameter of the rods would not sufficiently intercept the light vibrating in a plane transverse to their length.

It is expected to continue the investigation with artificial light and other varied conditions, followed by a later account.

ELIHU THOMSON

THOMSON LABORATORY OF GENERAL ELECTRIC Co., LYNN, MASS.

May 23, 1921

EDWARD BENNETT ROSA

DR. EDWARD B. ROSA, chief physicist of the Bureau of Standards, at Washington, died suddenly at his desk on Tuesday afternoon, May 17, 1921. Dr. Rosa was at the time the chief of Division I. of the Bureau of Standards, the functions of which include research, standardization and testing in the fields of electricity, magnetism, photometry, radio communication, radium, X-ray, and public utilities. Dr. Rosa was appointed physicist in the Bureau in 1901. In 1910 he was given the grade of chief physicist. Dr. Rosa's painstaking accuracy in scientific research is well known among specialists in the fields in which he worked. His investigations have been published in 36 scientific publications of the bureau and 4 technologic papers, not to speak of a large number of special reports, circulars, and articles in technical journals.

Among the researches of unusual interest may be mentioned the precise determination of the value of the coulomb, the value of the ampère, and of the ratio between the electrostatic and the electromagnetic units of electricity. His other laboratory researches included a wide range of problems chiefly connected with the improvement of the standards and methods used in precise electrical measurements.

Perhaps one of the most striking examples of Dr. Rosa's thoroughness and success in securing the cooperation of the technical groups interested may be found in the development and publication of the National Electrical Safety Code, the revised form of which has just recently appeared as a "Handbook" issued by the Bureau of Standards.

In his work as administrator he successfully organized the work of electrical testing, photometry, radium testing, and research and standardization work involved in radio communication. Dr. Rosa showed a deep interest in all phases of the bureau's development, and will be remembered with profound respect and admiration by his colleagues. His work will endure as a permanent foundation for the branches of physics and electrical engineering to which he devoted so many useful years of his life.

S. W. STRATTON

DEPARTMENT OF COMMERCE,
BUREAU OF STANDARDS

SCIENTIFIC EVENTS

THE HARPSWELL LABORATORY

THE Harpswell Laboratory was founded at South Harpswell, Maine, in 1898, as a summer school of biology by Dr. J. S. Kingsley, then professor of biology in Tufts College, Massachusetts. In 1913 it was reorganized as a scientific corporation under the laws of the state of Maine, with a board of ten trustees. Up to 1920, ninety-two scientists have worked in its laboratory at South Harpswell and over one hundred and ten papers have been published, as a result of this work, in American and foreign journals of biology.

In the spring of 1921 the Harpswell Laboratory became a member of "The Wild Gardens of Acadia" Corporation, and this corporation alloted to the Harpswell Laboratory a tract of land of abundant acreage for its purposes and further growth at Salisbury Cove, Maine, on Mount Desert Island, with shore frontage and favorable life conditions, upon which the Harpswell Laboratory has established its Weir Mitchell Station. In its new site the laboratory is in close contact with the wild life sanctuary of Lafayette National Park, created recently on Mount Desert Island by the United States through the efforts of a group of its summer residents. This is the only National Park in the eastern portion of the Continent and the only one in the country

in direct contact with the sea. This secures a permanent and rich area for biological study in every field, vertebrate and invertebrate.

Salisbury Cove is an old fishing and farming hamlet on the north shore of Mount Desert Island about five miles from the town of Bar Harbor and on the county road from it to the town of Ellsworth on the mainland, where there is a railroad station and junction. The village of Salisbury Cove is a market gardening and farming community of quiet and simple kind, but Bar Harbor has good stores of every sort, an excellent hospital, express, telegraph, cable facilities, good train service. The class in zoology will be conducted by the acting director, Professor Ulric Dahlgren, of Princeton University, and two assistants, for six weeks, from July 6 to August 17, in which types of the principal groups of the animal kingdom will be studied as to their habits, structures and classification, together with a number of the more important subjects of general biology. Independent research workers may obtain rooms that can be occupied from June 25 to September 15.

PRESENTATION TO DR. FREDERICK BELDING POWER

Dr. Frederick Belding Power, chemist in charge of the phytochemical laboratory, Bureau of Chemistry, Department of Agriculture, was presented with a gold medal by Mr. Henry S. Wellcome, of London, before a gathering of distinguished guests, in the auditorium of the Cosmos Club, on the afternoon of May 9. The medal was given in recognition of Dr. Power's distinguished services to science during eighteen and one half years as director of the Wellcome Chemical Research Laboratories of London.

Dr. Charles D. Walcott, secretary of the Smithsonian Institution, presented the medal to Dr. Power on behalf of Mr. Wellcome, who although present was suffering from a severe throat affection. In his address Dr. Walcott spoke briefly of the life and discoveries of Dr. Power:

We have gathered here this afternoon to do honor to Dr. Frederick Belding Power, who for fifty years has spent his thinking hours among the complicated molecules of organic compounds; who, because he possesses that peculiar faculty of exhausting each subject which he takes up, has had the greatest influence both in America and Great Britain in raising the standards of our pharmacopœias; who has gained distinction by his most difficult and life-consuming researches into the chemical composition of plant compounds.

Dr. Power graduated from the Philadelphia College of Pharmacy in 1874, in the same class with his life-long friend, Mr. Wellcome, who urged him to pursue his studies in Germany. He spent the years from 1876 to 1880 in Strassburg, becoming the assistant of Flueckiger, one of the greatest pharmacologists of Europe. Returning to America, he spent nine years in the organizing and building up of the department and school of pharmacy in the University of Wisconsin, four years in researches on essential oils in a newly organized chemical works near New York, and in 1896 Mr. Wellcome appointed him director of his chemical research laboratories in London.

For eighteen and one half years he devoted his time exclusively to chemical research and the direction of a staff of research workers under him. One hundred and fifty important memoirs were published from the laboratories during this period. These covered a wide field of investigation, for which material was obtained from all parts of the world. Among these a very notable and complete study was made of the East Indian chaulmoogra oil, which resulted in the discovery of some physiologically active acids of an entirely new type. These form the basis of the new treatment of leprosy which gives promise of affecting a complete cure of one of the most terrible diseases of mankind.

During these years in London, Dr. Power had the opportunity of meeting and forming the close friendship of the foremost scientific men of Great Britain. The recognition of his work by the leading chemists and other scientists of Europe would be perhaps exemplified in the high tribute paid to him by the late Lord Moulton, one of the most learned and versatile men in Europe, who was entrusted by Kitchener with the task of producing the high explosives for the war. Shortly before his death he chided Mr. Wellcome for permitting Dr. Power (who for family reasons had returned to America) to leave Great Britain, for, as he remarked, "there was no one in Europe who could fill his place."

Dr. Walcott then formally presented the medal to Dr. Power, who expressed his appreciation of the honor bestowed upon him and his gratitude to Mr. Wellcome, saying:

I can assure you that this memento will always be regarded by me as one of my most precious possessions. As I stand here there come to me many happy recollections of the friendship that has continued for nearly half a century. It was twenty-five years ago when I left America to take charge of the laboratories.

There is one thought that is dominant in my mind, however, and that is an expression of gratitude to Mr. Wellcome. I am grateful for his encouragement and inspiration, but above all for having possessed for so many years so kind and true a friend.

MEDALLION OF THE WISCONSIN ACADEMY OF SCIENCES

A MEDALLION with which the Wisconsin Academy of Sciences, Arts and Letters commemorates its recent semi-centennial has been completed by Leonard Crunelle, Chicago sculptor, and is described in an article written by President E. A. Birge, of the university, for the forthcoming *Transactions of the Academy.*

The medallion bears the portraits of six distinguished members of the academy. Its obverse bears the figure of Minerva tending the lamp of learning and a motto from Lucretius, "Naturæ species ratioque." The reverse carries the inscription, "The Wisconsin Academy of Science, Arts and Letters, 1870–1920," and the portraits of the following six members:

William Francis Allen, hsitorian, professor of Latin and history at the university, 1867–1889, a great teacher and scholar; president of the academy from 1887 to 1889.

Thomas Chrowder Chamberlin, geologist, professor at Beloit College 1873–1882, director of the Wisconsin Geological Survey, 1876–1882, in charge glacial division of U. S. Survey, 1882–1887, president of the University of Wisconsin 1887–1892, head of the department of geology in University of Chicago, 1892–1919, now professor emeritus, Chicago; president of the academy, 1884–1887.

Philo Romayne Hoy, physician, naturalist, practising in Racine from 1846 to his death, ardent student of bird life and the biology of Lake Michigan; president of the academy, 1875–1878.

Roland Duer Irving, geologist, professor in the university from 1870 until his death in 1888, important member of the Wisconsin and U. S. Geological surveys and a leading authority on the geology of the Lake Superior region, 1873–1888; president of the academy, 1881–1884.

Increase Allen Lapham, naturalist and geologist, resident of Milwaukee 1836–1875; collector and cataloguer of plants and fossils; state geologist, 1873–1875; charter member of the academy and its secretary from its organization until his death in 1875.

George Williams Peckham, zoologist, teacher, high school principal and superintendent of schools in Milwaukee, 1873–1896, head of Milwaukee public library, 1896–1914; authority on habits and classification of insects; president of the academy, 1890–1893.

The medallion was made possible by a fund of $1,200 for designing it and making the dies. This was donated by the following friends: A. J. Horlick, Racine; F. A. Logan, Chicago; F. P. Hixson, La Crosse; Mrs. C. W. Norris, Milwaukee; and E. A. Birge, T. E. Brittingham, C. K. Leith, M. S. Slaughter, and C. S. Slichter, all of Madison. Other friends have contributed to a fund by which copies of the medallion will be distributed.

The six members were chosen partly for their intellectual eminence for their services to the academy, and in part for the periods in which their lives and activities fall. Three of them, Chamberlin, Hoy, and Lapham, were charter members. Each of the six served as president, except Lapham, who was secretary from its beginning until his death in 1875.

SCIENTIFIC NOTES AND NEWS

ON Mme. Curie's return from the Grand Canyon and Yellowstone Park, the Wolcott Gibbs medal was conferred on her by the Chicago Section of the American Chemical Society, and she was entertained by the University of Chicago and by the associated women's organizations. After a visit to Niagara Falls she proceeded to Boston, where among other functions a dinner was given in her

honor by the American Academy of Arts and Sciences. Mme. Curie planned to visit New Haven this week to be present at the installation of President Angell on June 22. She expected to sail with her daughters for France on June 25.

Dr. Carl L. Alsberg, having resigned as chief of the Bureau of Chemistry of the Department of Agriculture, to accept a position as one of the three directors of the Food Research Institute established at Stanford University by the Carnegie Corporation, the bureau chiefs of the department gave him a farewell dinner at the Cosmos Club on June 17. Dr. L. O. Howard acted as toastmaster and Assistant Secretary Ball spoke informally and Dr. Alsberg replied.

At the annual commencement of the Worcester Polytechnic Institute on June 10, the class of 1871 celebrated the fiftieth anniversary of its graduation, and H. P. Armsby of that class received the honorary degree of doctor of science, this being the first honorary degree ever conferred by the institute.

The degree of doctor of science was conferred on Dr. Edward Kenneth Mees, research chemist of the Eastman laboratory, at the seventy-first commencement of the University of Rochetser.

Indiana University has conferred the degree of LL.D. on W. S. Blatchley, formerly state geologist of Indiana.

Franklin College at its commencement on June 8 conferred the honorary degree of doctor of humane letters on Dr. Albert Perry Brigham, professor of geology in Colgate University.

Miss Annie J. Cannon, of the Harvard College Observatory, has received from Groningen University in Holland an honorary doctor's degree in mathematics and astronomy, in acknowledgment of her work in the study of stellar spectra.

At the anniversary meeting of the Linnean Society of London on May 24 its Linnean gold medal was presented to Dr. Dukinfield H. Scott, for his services to recent and fossil botany.

Professor Dwight Porter, since 1883 a member of the civil engineering department of the Massachusetts Institute of Technology, and for twenty-five years professor of hydraulic engineering, has retired.

We learn from *Nature* that Dr. W. T. Calman, who has been in charge of the Crustacea at the Natural History Museum since 1904, the author of "The Life of Crustacea" and of numerous articles on this group, has been appointed deputy keeper in the department of zoology.

A number of changes have recently been made in the scientific staff of the Australian Museum, Sydney. Dr. C. Anderson, who has been mineralogist since 1901, succeeds the late R. Etheridge, Jr., as director. Mr. A. Musgrave fills the vacancy caused by the death of W. J. Rainbow, entomologist, and Messrs. J. R. Kinghorn and E. le G. Troughton, second-class assistants, have been promoted to be first-class assistants in charge of reptiles, birds and amphibians, and mammals and skeletons, respectively.

Dean Albert R. Mann, of the New York State Agricultural College at Cornell University, has declined the position of head of the New York State Agricultural Department. Reference was made in Science to "candidates" for this position. The word was not intended to imply that the position was being sought by the scientific men in question, but that their qualifications were such as to have led to the consideration of their appointment.

Dr. T. Mitchell Prudden has been elected a member of the International Health Board of the Rockefeller Foundation. Dr. Anthony J. Lanza, of Cleveland, has been appointed by the board to inaugurate a department of industrial hygiene in the new ministry of health in Australia.

Professor George Grant MacCurdy has leave of absence from Yale University for the academic year 1921–22. With Mrs. MacCurdy he sailed for Europe on June 18 to become the first director of the American School in France for Prehistoric Studies. The school is scheduled to open at the rock shelter of La

Quina near Villebois-Lavalette (Charente) on July 1.

Dr. Hugh H. Young, director of the James Buchanan Brady Institute, Johns Hopkins Hospital, will sail, June 25, for Europe. He will go first to Paris to attend a medical meeting and later to London, returning to the United States in August.

The Oxford University expedition to Spitzbergen is not only biological, as was stated in a note of our issue of May 13, nor mainly ornithological. It will include three zoologists, three ornithologists, a botanist, a geologist, a glaciologist, a geographer, a mineralogist, and a meteorologist, who, together with Dr. T. G. Longstaff will constitute an inland sledging party to explore and map an untouched area of New Friesland. Mr. Seton Gordon is accompanying the expedition as photographer. Mr. Julian S. Huxley is organizing the scientific work apart from the ornithology, which is under the direction of the Rev. Francis C. R. Jourdain.

A conference on conservation of resources of interior waters, called by the Secretary of Commerce, met at Fairport, Iowa, June 8 to 10. The chairman was Professor Stephen A. Forbes, of the Illinois State University and State Natural History Survey. Vice chairmen were Professor Herbert Osborn, Ohio State University; Carlos Avery, Minnesota State Fish and Game Commission; Professor H. C. Cowles, University of Chicago; J. E. Krouse, Davenport, Iowa; and Dr. A. T. Rasmussen, La Crosse, Wis.

A grant of $450 has been made by the Committee on Scientific Research of the American Medical Association to Dr. Herbert M. Evans of the University of California for the continuance of his researches on the relations between ovulation and the endocrine glands.

UNIVERSITY AND EDUCATIONAL NOTES

The Carnegie Corporation and the General Education Board have each given half of $3,000,000 to the medical department of Vanderbilt University as an endowment. Funds for the erection of new buildings are available from appropriations of $4,000,000 made by the General Education Board in 1919.

New York University has received a gift of $150,000 in memory of Dr. A. Alexander Smith, from Mrs. Helen Hartley Jenkins to complete the endowment of the department of medicine, for which Mrs. Jenkins had previously given the sum of $100,000.

Dr. C. H. Clapp, president of the Montana State School of Mines at Butte, has been elected president of the State University of Montana, to succeed Dr. E. O. Sisson, who recently resigned.

At the annual meeting of the university senate and board of trustees of Syracuse University there was established a research professorship in zoology, and Professor Charles W. Hargitt, since 1891 head of the department of zoology, was made its first incumbent. At his own request Professor Hargitt is relieved from active direction of departmental routine and Professor W. M. Smallwood becomes director.

Dr. John W. M. Bunker, formerly instructor in the department of sanitary engineering at Harvard University and for the last six years director of the biological laboratories of the Digestive Ferments Company, has been appointed assistant professor of biochemistry at the Massachusetts Institute of Technology.

Dr. Christian A. Ruckmick, of the University of Illinois, has accepted an appointment as associate professor of psychology in Wellesley College.

Dr. E. V. Cowdry, since July 1, 1917, professor of anatomy at the Peking Union Medical College, Peking, China, has resigned that position to accept an appointment as associate member of the Rockefeller Institute for Medical Research. Dr. Davidson Black, formerly associate professor of embryology and neurology of the Peking College, has been appointed professor and head of the department of anatomy at the Peking College, succeeding Dr. Cowdry.

DISCUSSION AND CORRESPONDENCE

NEWTON'S CORPUSCULAR THEORY OF LIGHT

To the Editor of Science: For more than half a century various text-books on physics and other publications dealing with the phenomena of light, contain assertions to the effect that Newton's corpuscular theory of light received a knock-out blow when it was demontrated that light required a longer time to pass through water than through air.

Quoting, for example, from the last (11th) edition of the Encyclopædia Britannica, Vol. XVI., page 618, we read:

> In the earlier part of the 19th century, the corpuscular theory broke down under the weight of experimental evidence, and it received the final blow when J. B. L. Foucault proved by direct experiment that the velocity of light in water is not greater than that in air, as it should be according to formula (1), but less than it, as is required by the wave theory.

The object of this note is to show that the observed data are just as favorable for Newton's theory as they are for the wave theory of light.

Compared with Newton's corpuscle, the hydrogen unit of chemistry must evidently be regarded as a very large mass.

In passing between the molecular masses (H_2O) of which the water is composed, the path of the corpuscle would be much longer than the path in air between the widely separated N_2, O_2, H_2O and other masses. Consequently, if the ratio of the actual length of the path in water to the actual length of the path in air is greater than the ratio of the velocity in water to the velocity in air, the time required for the corpuscle to pass through the water with the greater velocity, will be longer than that required to pass through the air.

J. M. Schaeberle

Ann Arbor,
May 31, 1921

GERMAN SURTAXES ON SCIENTIFIC PUBLICATIONS

To the Editor of Science: I read with interest the letter of M. W. Senstius in Science for April 8, 1921, in which he stated that a publisher in Leipzig had informed him that he had "abolished all foreign surtaxes on journals published by his firm," and that the publisher stated further that it was a "matter of regret to him that he is not (yet?) at liberty, owing to the binding regulations of the Börsenverein, to do the same with his own books."

I at once wrote to the publisher, Wilhelm Englemann, stating that I had read Mr. Senstius's letter in Science, and inquired whether the journal—*Botanische Jahrbücher*—was included in his list of exempt publications, and what the subscription rate of the periodical would be to us. I give below a close English translation of Mr. Engelmann's reply under date of May 2, 1921:

> In answer to your very valued letter of April 12, 1921, may I reply that Mr. Senstius in his article in Science of April 8 emphasizes that all the journals *which appeared from my press after January 1, 1921, would be supplied without the exchange tax* (*Valuta Aufschlag*)*!*
>
> On all journals and sets (Sammelwerke) appearing before the end of 1920 there is a publisher's additional charge (surtax, *Verlegerteuerungszuschlag*) of 200 per cent. plus, at the time only, 100 per cent. exchange tax exempt! In accordance with the enclosed circular this publisher's surtax was increased from May 1, 1921, to 300 per cent. of which you will please take note!
>
> With reference to Series I., Botan. Jahrbücher, this 300 per cent. is charged, plus the Valuta additional!

On the back of Engelmann's letter were two notices rubber-stamped, the first stating that his firm would supply all periodicals issued after January 1, 1921, without the Valuta charged, but the second rubber-stamped notice stated that on account of the unusually stringent conditions, there would be added a 300 per cent. publishers' excess charge on all of his publications which appeared previous to the close of 1920, as stated in the letter just quoted. The enclosed circular, to which his

letter referred, contained the same statement, indicating in addition that the 300 per cent. additional charge would become effective on and after May 1, 1921.

C. STUART GAGER

BROOKLYN BOTANIC GARDEN

QUOTATIONS

CENTENARY OF THE FRENCH ACADEMY OF MEDICINE

OUR Paris correspondent has told of the celebration, beginning Dec. 20, 1920, of the most important anniversary connected with French medicine—the centenary of the Academy of Medicine, which has the same preeminence in medicine that the general French Academy bears in relation to the more liberal arts. Its roster bears only the names of those who have by years of achievement won recognition in the profession, and there are few below middle life who have been accorded the honor of election. Trousseau, who received the academy prize in 1837 for his classical treatise on laryngeal phthisis, was considered unusually fortunate in that he gained admission in his thirty-sixth year. The academy was founded in 1820 by royal edict of Louis XVIII., although its name appeared as early as 1804 as an entirely ephemeral institution, the chief interest attaching to it being that Dr. Guillotin was one of its presidents. The French Revolution, with its ruthless submergence of all that pertained to the old order of things, dissolved all medical associations, and among these the Academy of Surgery and the Royal Society of Medicine, which after nearly a century of existence disappeared, to come to life again in the founding of the present Academy of Medicine. The initial concept of the academy was the formation of a body which, by its scientific labors and achievements, should be an asset to the state in matters of public health. The decree which constituted it lays down certain functions which it was to carry on. Among them were improvements in the method of vaccination against smallpox, the measures for the control of epidemic diseases, regulations as to and concerning legal jurisprudence, and the examination of and passing on new remedies, together with the limitation of the sale of nostrums, both those of French and those of foreign origin. While the present academy still holds the latter function, its work, to a large degree, is hampered by the administration of French law, as was pointed out in a former editorial.

The *Bulletin* of the Academy for Dec. 20–22, 1920, is devoted to a review of the history and labors of the society since its foundation. It records a century's achievement by men whose names are known the world over: Pinel, Laënnec and Broussais in the early days; Trousseau in the thirties; Villemin and Pasteur, and on down through the list of those who have added to the sum of certain knowledge which has lifted medicine from scientific guesswork to the dignity of a precise science.—*Journal of the American Medical Association.*

SPECIAL ARTICLES

RESISTANCE TO STEM RUST IN KANRED WHEAT

A CYTOLOGICAL study of *Puccinia graminis tritici* on Kanred wheat, conducted by the Office of Cereal Investigations in cooperation with the California Agricultural Experiment Station, has yielded several facts of interest.

The strain of stem rust under observation and herein reported was obtained from the Berkeley breeding plats. Seedlings of susceptible varieties of wheat grown in the greenhouse produced abundant pustules but, in repeated trials with Kanred, the fungus failed even to produce flecks.

It was found that the urediniospores germinate readily on Kanred leaves and that the germ tubes make their way directly to the stomata. On reaching a stoma, the tip of the germ tube swells to form an appressorium and practically all of the protoplasm flows into it, leaving the germ tube empty. Under favorable conditions for germination these appressoria develop promptly and in great numbers. Often one may observe two, three, and even four spores, with their appressoria, crowded together at a single stoma.

In spite of this, relatively few appressoria enter the stomatal slit in Kanred to form my-

celium within the host. Six days after inoculation, only five out of a hundred appressoria had entered. Material taken eight, ten, and even twelve days after inoculation still showed numerous appressoria and a relatively limited number of infections. For greater accuracy, counts were made and the results tabulated as follows:

No. of Days after Inoculation	Total No. of Sporelings Counted	No. of Entries	Percentage of Entries
6	100	5	5
8	133	14	10 +
10	77	7	9
12	145	16	11 +

Under the conditions of this experiment, only about ten per cent. of the young rust fungi enter. The other ninety per cent. remain outside the stomata until they dry and fall off. By the twelfth day, under greenhouse conditions, practically all the appressoria are withered and collapsed.

Tangential sections of Kanred and Mindum leaves were examined. In these the stomatal slit was measured in length, in width at center and at its widest point, which is near the end, and averages taken. The same was done with Mindum, a durum variety somewhat resistant to this strain of rust. The stomatal aperture in Kanred is extremely long and narrow, while that of Mindum, a less resistant variety, is short, and very variable in width, the average width being about *twice* that of Kanred. In Mindum, the rust sporeling enters freely, while in Kanred nine tenths of them are excluded. It is possible that the naturally small stomatal opening of Kanred is still further narrowed by the action of the guard cells when an appressorium comes in contact with the stoma. A more comprehensive and fully illustrated account, including similar observations on other varieties of wheat, and reporting resistance phenomena which follow actual infection, is now in preparation.

Ruth F. Allen

College of Agriculture and United States Department of Agriculture, Cooperating,
Berkeley, California

THE AMERICAN CHEMICAL SOCIETY

ROCHESTER MEETING

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

H. N. Holmes, *chairman*
S. E. Sheppard, *secretary*

Symposium on Contact Catalysis

Platinum black and carbon monoxide. Esterification by silica gel: C. H. Milligan and E. Emmet Reid. A mixture of equivalent amounts of acetic acid and ethyl alcohol has been passed over silica gel at 150°, 250°, 350° C. It has been found that silica gel is a very active catalyst, more than twice as active as titania, the best catalyst previously known for this reaction. When the mixture is passed rather slowly at 150° the percentage of esterification is 75 to 80, which is much beyond 67 per cent., the accepted limit for this reaction.

Adsorption by oxide catalysts and the mechanism of oxidation processes: A. F. Benton.

Dissociation of some mixed oxides: J. C. Frazer.

The adsorption of gases by metallic catalysts: H. S. Taylor and R. M. Burns. The adsorptions of hydrogen, carbon monoxide, carbon dioxide and ethylene by finely divided nickel, cobalt, iron, copper, palladium and platinum has been found to be of a specific character quite different in nature from adsorption by porous inert adsorbents of the charcoal type. The extent of adsorption was shown to be a function of the mode of preparation and to be especially less pronounced the higher the temperature at which the metal was prepared. The analogy of this fact with the corresponding facts of catalytic behavior has been noted. Adsorption isotherms at 25° C. of hydrogen with nickel, and of carbon monoxide with copper have shown that adsorption increases rapidly with increasing partial pressures below 300 mm. and becomes practically independent of pressure above this pressure.

The action of nickel on diethyl ether: A study in contact catalysis. Preliminary report: Francis L. Simons. A report is given of preliminary work in the study of the catalytic decomposition of ether by nickel. The study was undertaken in the hope of throwing light on the mechanism of the action of nickel on alcohol and the simpler esters. The apparatus used is described in detail and the general procedure given. From the results so far, it appears that ether is decomposed into H_2, C_2H_4 and CH_3CHO, as Bancroft suggests. The compo-

sition of the gas evolved during the reaction is satisfactorily explained on this basis. The work is being continued.

E. p. m. as catalyst: C. H. MILLIGAN and E. EMMET REID. It has long been known that ethylene can be used in place of ethyl chloride in the preparation of ethyl benzene by the Friedel and Crafts reaction but the absorption rate is so slow under usual conditions that the method has not been attractive for preparing ethyl benzene. We find that the reaction can be made to go so rapidly by using a high speed stirrer that this becomes an efficient preparation method. A mixture of 250 g. benzene and 50 g. aluminum chloride absorbs as much as 1,800 c.c. of ethylene per minute when stirrer is run at 1,300 r. p. m.

Catalysis in the interaction of carbon with steam and carbon dioxide: H. A. NEVILLE and H. S. TAYLOR. The catalytic activity of alkali carbonates, alkaline earths and various salts in promoting reaction between steam and carbon has been shown to be paralleled by similar effects in the acceleration of interaction of carbon and carbon dioxide. In each case potassium carbonate has been found to be the most active salt catalyst. Reduced nickel promotes interaction of carbon and carbon dioxide markedly. In explanation of the mechanism of the two reaction processes it has been shown that adsorption of carbon dioxide by carbon at 445° C. is markedly increased by addition to the carbon of such accelerating agents, although these latter themselves show no adsorptive capacity for the gas.

Catalysis in the reduction of oxides and the catalytic combination of hydrogen and oxygen: R. N. PEASE and H. S. TAYLOR. Oxygen and water vapor, present in hydrogen used for reduction of copper oxide, markedly inhibit the action; addition of reduced copper to the oxide appears to accelerate the reaction. The induction period in the reaction is attributed (*a*) to initial drying of the oxide, (*b*) to slow initial formation of copper which then acts as a catalyst. It is doubtful whether the catalytic combustion of hydrogen and oxygen in presence of copper can be represented as an alternate oxidation and reduction process as it has been found that when hydrogen containing oxygen is passed over copper oxide at 150° C., no appreciable water is formed and, at lower temperatures, the activity is reduced as the catalyst becomes progressively oxidized. The formation of water in presence of copper may take place through interaction of hydrogen on an oxygen molecule which is in process of combining to form oxide, that is, at the instant of collision with the copper surface.

A case of autooxidation: $MnO_2 \rightarrow HMnO_4$: J. C. FRASER.

Oxidation and reduction by organic compounds: C. H. MILLIGAN and E. EMMET REID.

The action of alumina, titania, and thoria on ethyl and isopropyl acetate: HOMER ADKINS and A. C. KRAUSE.

The catalytic electrolytic oxidation of SO_2*:* COLIN G. FINK. The electrolytic oxidation of SO_2 with various anodes was investigated. It was found that graphite anodes will catalyze the oxidation providing ferrous-ferric ions are present in solution. In the absence of iron, no catalytic effect due to the graphite could be observed. On the other hand, an inert anode such as ferrosilicon, in the presence of ferrous-ferric ions will not catalyze the SO_2 oxidation. The combined effect of the graphite anode and the iron is essential to accelerate the reaction.

The decomposition of ethyl acetate induced by catalytic nickel: HOMER ADKINS and P. W. SIMMONDS.

The catalytic influence of foreign oxides on the decomposition of silver oxide, mercuric oxide and barium peroxide: JAMES KENDALL and FRANCIS J. FUCHE. The effect of foreign oxides on the temperature and rate of decomposition of silver oxide, mercuric oxide and barium peroxide under an oxygen pressure of one atmosphere has been experimentally investigated. In almost all of the systems examined, the added oxide induces a considerable change in the decomposition temperature. Most commonly there is a marked lowering in this point; thus (to cite an extreme case) an equimolecular mixture of BaO_2 and CuO has an oxygen equilibrium pressure of one atmosphere at 355°, approximately 500° below the decomposition temperature of pure BaO_2. In a few systems a comparatively small rise in the decomposition temperature is indicated. In all instances, however, the rate of oxygen evolution is significantly increased.

A new clock reaction: G. S. FORBES, H. W. ESTILL, and O. J. WALKER. The induction period, t, preceding precipitation of As_2S_3 from H_3AsO_3 or H_3AsO_4 in the presence of $H_2S_2O_3$, is extraordinarily sharp and reproducible. In the case of H_3AsO_3, $1/t = KC$ $Na_2S_2O_3$, but is independent of C H_3AsO_3, and also of C H provided $HC_2H_3O_2$ or very dilute HCl is used. The period increases greatly with C HCl. The rate of precipitation, also highly reproducible, is very great at first, di-

minishes very rapidly, but may not become zero before 3,000 hours at room temperature. With $HC_2H_3O_2$ the initial rate $= k'C$ H, but with moderate values of C HCl this proportion becomes inverse. Many other regularities, likewise affording clues to the reaction mechanism, have been noted.

The volumetric oxidation of sulfide to sulfate: H. H. Willard and W. E. Cake. The alkaline sulfide solution obtained by absorbing H_2S in NaOH is oxidized quantitatively to sulfate if excess of standard hypobromite or hypochlorite is added, and sufficient hydroxide is present. The excess is then determined by adding KI, acidifying, then titrating the iodine with thiosulfate. The method may be applied also to freshly precipitated sulfides, such as ZnS. Since four times as much oxygen is required in this reaction as in the usual iodine titration, the method is especially suitable for small amounts of sulfur.

Making scientists: Recovering the normal curiosity in college students: Edward Ellery. A normal boy and the investigating scientist have this in common—they are both living interrogation points. The investigator minus a "why" is an anomaly, and a boy without it is abnormal, if not defective. If college training knocks the natural "why" out of a boy, a reform can not too soon be instituted. Here is the way Union College is working to effect such a reform. At every opportunity work is required that takes the boy away from his textbook and laboratory manual and into the library for consultation of larger treatises and current periodicals. In the summer months, at the end of the junior year, a few of the best students receive appointments to the research laboratory of the General Electric Company, where they handle a piece of research work under the direct supervision of the leading members of the staff of that organization. In their last year in college, their time in the chemical laboratory is given to a continuation of this research work, or to a new problem. It is only the unconquerably dull boy that fails to react to this effort to awaken his natural "why."

The apparent irreversibility of the calomel electrode: A. W. Laubengayer. When mercury is made anode in a chloride solution a high-resistance, black film forms over the surface of the mercury. This is composed of drops of mercury and particles of mercurous chloride. It is not known why mercurous chloride should be adsorbed so closely and mercurous sulphate not.

The theory of hydrogen overvoltage: D. A. MacInnes and W. R. Hainsworth. Experiments on the effect of pressure on hydrogen overvoltage show that the variation produced is in the direction predicted by the theory advanced by MacInnes and Alden; *i.e.*, the overvoltage increases when the pressure is decreased. On the other hand, computation of the overvoltage from the size of evolved bubbles fails for layer potentials, since the phenomena at metal surfaces get farther and farther away from equilibrium conditions as higher overvoltages are reached. However, the fundamental assumption that overvoltage is an extreme case of concentration polarization, retains its usefulness in explaining the experimental results, at least for the lower potentials.

The hydrogen electrode under high pressures: W. R. Hainsworth. The variation of the E. M. F. of the cell, $H_2$1HCl (C.1nHCl), HgCl/Hg, with pressure has been measured from one to 400 atmospheres. It was found that thermodynamic calculations involving (1) the deviation of hydrogen from a perfect gas, (2) the partial molal volume of HCl in 0.1 NHCl, (3) the molal volumes of mercury and calomel, and (4) the change of HCl concentration with the compressibility of the solution, served to reproduce the observed potential of the cell within 0.2 mv. throughout the pressure range studied. This leads to the conclusions, (*a*) that the "thermodynamic environment" is not appreciably changed by the molecular hydrogen in solution, or by compression, and (*b*) that the fugacity (or effective pressure) of hydrogen can be calculated up to 400 atmospheres from the equation of state developed by Keyes.

Potassium ammonoaluminate and ammonomanganite: Francis W. Bergstrom. The author has added an ammonoaluminate and an ammonomanganite of potassium to Franklin's list of salts formed by the action of potassium amide, in liquid ammonia solution, on the amides, imides or nitrides of other metals. The aluminate has been prepared by the action of a solution of potassium amide on amalgamated metallic aluminium. Its composition is represented by the formula $Al(NHK)(NH_2)_2$. Potassium ammonomanganite has been obtained in the form of rose colored crystals by the action of an excess of potassium amide on manganese thiocyanate in accordance with the reaction represented by the equation

$$Mn(SCN)_2 + 4KNH_2 = Mn(NHK)_2.2NH_3 + 2KSCN.$$

A quantitative study of adsorption in solution and at interfaces of sugars, dextrin, starch, gum arabic and egg albumen, and the mechanism of their action as emulsifying agents: George L. Clark and Wm. A. Mann. By the most accurate method known—the use of the stalagmometer for measurement of interfacial tension and the Morgan drop weight apparatus for measurement of surface tension of single liquids—the adsorption of sugar in solution has been determined to be negative, the adsorption increasing in ratio with increase in concentration of sugar, while the adsorption of sugar at the interface is positive and increases in the same ratio as in solution. Dextrin and starch, in very dilute solutions, are negatively adsorbed in solution but, in more concentrated solutions, are positively adsorbed while at the interface they are negatively adsorbed—starch more so than dextrin. Gum arabic behaves, in this respect, in the same manner as starch. A favorable surface tension, seemingly, is not a prerequisite for a good emulsion with any solution studied, although viscosity is an important factor. Better emulsions have been obtained with egg albumen—saturated solutions—than with any other solution under inspection.

The preparation, properties and molecular volume relationships of the ammines and hydrates of cobaltous fluoride, bromide, nitrate, carbonate and citrate: George L. Clark and H. K. Buckner. The molecular volume compression of the subsidiary valence groups, NH_3 and H_2O, were studied in the same manner as in the previous work on the chloride and sulphate of cobalt (*J. Am. Chem. Soc.*, 42, 2483 (1920)) in light of difference in volumes between anion and cation and possibilities of space cavities. It was confirmed that the larger the difference between anion and cation the greater the possibility of cavities, and the less the compression of NH_3 and H_2O required the more stable the compound and the greater the possibility of holding a maximum number of groups. The various compounds prepared and studied are distinctly new with the exception of cobaltous bromide hexammine and cobaltous nitrate hexammine, the following being representative: cobaltous fluoride hexammine, cobaltous nitrate di-hydrate, ammines of cobaltous nitrate indicating more than six subsidiary valence groups and ammines of cobaltous carbonate and citrate.

Emulsification with soaps of linoleic and ricinoleic acids: George L. Clark and H. K. Buckner. This work has involved the quantitative study by means of surface energy measurements for solutions and at the interface between aqueous solution and a pure oil by the drop weight method of the following points: the solubility in water of the free acids from the log. concentration-surface tension curve; the adsorption at the surface and the volume occupied by each molecule in the surface; the surface tensions of various concentrations of the soaps in solution, the effect upon the interfacial tension between water and pure toluene, the effect of the hydrolysis of the soap and the prevention of hydrolysis by the addition of various concentrations of NaOH to a given concentration of the soap; a test of the antagonistic effect of sodium and calcium soaps by testing the effect upon the interfacial tension between water and toluene containing a small amount of the free acid of adding various salts of sodium and calcium, resulting in the fact that the sodium salt promotes emulsions of oil in water and calcium salts promote emulsions of water in oil; and finally a thorough comparison of all the data so obtained with previous work on soaps of palmitic, stearic and oleic acids. All results of this purely quantitative study are necessarily numerical and can not be included in a short abstract.

Notes on the preparation of pure platinum: Edward Wichers. The paper briefly states the method used in preparing platinum sponge free from other platinum metals and base metals, and describes in more detail the work that has thus far been done on the conversion of this sponge to compact metal with minimum contamination. E.M.F. tests show the resulting platinum to be of higher purity than the best previously obtainable, *i.e.*, the thermoelement wire of Heraeus, and show the difference in purity to be a matter of calcium content. Results of experiments with magnesia refractories are also given. There is a brief outline of further work to be done on this subject.

Modified method for the determination of iron and vanadium after reduction by hydrogen sulphide: G. E. F. Lundell and H. B. Knowles. Published methods for the determination of iron and vanadium after reduction by hydrogen sulphide ordinarily yield high values. A modified method which is sufficiently accurate for most purposes is presented, and a procedure for accurate analysis is outlined.

The free energy of dilution of hydrobromic acid; the activities of its ions in very dilute and con-

centrated solutions: Miller Spencer and Albert G. Loomis.

The ultra-violet arc spectrum of yttrium: L. F. Yntema and B. S. Hopkins. The ultra-violet arc spectrum of Y was measured, using the yttrium oxide prepared by one of us for the determination of the atomic weight value accepted by the International Committee. The spectrograph used is an autocollimating quartz prism machine manufactured by Adam Hilger, of London. A current of 4 amperes at an E.M.F. of 220 volts was passed between vertical copper electrodes, the lower of which held the Y_2O_3 in its crater. Several prominent lines, attributed to Y in the literature, were absent, and several new lines were measured. The results given are the mean of five determinations.

On the viscosity of gelatin sols: Robert Herman Bogue. Experiments were carried out upon gelatin sols to accurately determine the relation between viscosity and concentration. The data have been applied to Hatschek's formula for the viscosity of emulsoids and the value A^1/A, representing the volume occupied per unit weight of dispersed phase, was shown not to be constant with varying concentration, but to rise to a maximum and thereafter regularly decline. A tentative explanation is presented based upon the effect which increasing concentrations of dispersed phase will have upon the surface tension of the dispersion medium. An empirical expression defining the departure of the values obtained under varying conditions for Hatschek's constant is given.

The structure of molecules of water: Irving Langmuir. Dennison has recently shown by X-ray crystal analysis that ice consists of molecules of the formula H_4O_2. In view of our knowledge of the structure of atoms it is not possible to account for the existence of this molecule on the basis of quadrivalent oxygen atoms. If pairs of electrons (duplets) constitute the valence bond, there can be no such bond between the two oxygen atoms. A structure for this molecule is therefore proposed in which the four hydrogen nuclei bind the two oxygen atoms. The duplet held by each hydrogen nucleus has one of its electrons in each of the oxygen octets, instead of the more usual arrangement in which both electrons of a duplet form part of the same octet.

The purification of helium by means of charcoal: L. Finkelstein.

The importance of diffusion in organic electrochemistry: Robert E. Wilson and Merrill A. Youtz. The authors, in searching for definite evidence of depolarization in the electrolytic halogenation of organic compounds, found that either slow reaction rate or slow diffusion, or both, prevented any marked depolarization. Experiments on the oxidation of $FeCl_2$ in HCl gave surprisingly accurate information as to the rate of diffusion under a variety of conditions, and showed that without stirring there is a film of stationary liquid about 0.5 mm. thick through which diffusion must take place. This emphasizes the great importance of violent stirring and of the use of rapidly diffusing inorganic carriers to extend the sphere of the organic reaction from a surface to a volume.

Observations on the drying and swelling of gelatine gels: S. E. Sheppard and F. A. Elliott. Attention is drawn to the importance of capillarity in the first phase of drying of jellies. It is shown that this, in conjunction with factors depending upon the shape of the jelly, causes the formation of an exo-skeleton tending to conserve or increase the original external surface extension. It is chiefly due to this, rather than to any internal supermolecular structure, that dried jellies on reswelling in water tend to return to their original concentration.

Note on the influence of silver salts in catalyzing the decomposition of ammonium persulphate solutions: S. E. Sheppard and A. Ballard. The influence of silver salts in facilitating the decomposition of ammonium persulphate in solution, first observed by H. Marshall and J. Inglis, has been confirmed, and quantitative data on the rate of change in relation to the silver content obtained.

Further developments of the hydrogen electrode: Felix A. Elliott. Two new forms of hydrogen electrode were described representing probably the limits of simplicity and ruggedness without reducing accuracy and rapidity of operation. Especial attention has been given in designing this new apparatus to reduce the internal resistance to the lowest possible value so that a less sensitive and hence cheaper, simpler and portable electrical measuring instrument might be used. Such an instrument was described, working on the potentiometer principle and employing a pivot type movement. Examples of results obtained with the two types of apparatus indicate that potentials are reproducible to about 0.1 mv.

Note on silver soap gels: G. Stafford Whitby. It has been observed that the silver salts of the fatty acids are capable of giving reversible gels in a variety of organic liquids—particularly in the

homologs of benzene and in halogenated derivatives of benzene and its homologs. The silver salts form gels at a lower point in the series of saturated fatty acids than do the alkali-metal salts; gels being obtained with silver caproate. A number of regularities were discernible. The silver salts of the higher members of the saturated fatty acid series show a greater solvation capacity than those of the lower ones. None of the saturated fatty acid silver salts gave a gel in benzene; but silver oleate did. Speaking generally, in the case of solvents of the same general chemical character, the higher the boiling point of the solvent, the greater appeared to be the solvation capacity of a given salt, and the smaller the extent to which the gel from a given salt suffered syneresis.

Catalytic effect in the reaction between ketones and halogens in aqueous solutions: F. O. RICE. The velocity constant of the reaction between acetone and bromine is independent of the bromine concentration and Lapworth (*J. C. S. Trans.*, 1904, p. 30) explained this by saying that the acetone slowly enolized and the addition of bromine and splitting off of hydrobromic acid were practically instantaneous. This is probably incorrect since higher ketones have the same velocity constant as acetone, and an explanation based on the radiation theory was offered. The reaction is accelerated by neutral salts contrary to Lapworth's statement.

The transference numbers of sulfuric acid by the concentration cell method: A. L. FERGUSON and W. G. FRANCE. A cell combination was used which permitted the measurement of all the required potentials from one set-up. The value obtained for the transference number for the anion in concentrations between $M/10$ and $M/100$ at 25° C. was $.1868 \pm .0007$. The method was shown to be highly reliable. In all of the calculations it was assumed that sulfuric acid dissociates into two hydrogen and one sulfate ion. This assumption was substantiated by the results obtained. A formula for boundary potential was developed in which boundary potential may be obtained from potential measurements alone.

The influence of gelatin on the transference numbers of sulfuric acid: ALFRED L. FERGUSON and W. G. FRANCE. The transference numbers were determined by the concentration cell method. Solutions of sulfuric acid containing from 0.5 per cent. to 20 per cent. gelatin were used. The transference numbers of the anion increased from .187 for pure acid to .685 for acid containing 20 per cent. gelatin. In the 20 per cent. gelatin solution the boundary potential of both concentration cells became zero. The decrease in conductivity was approximately proportional to the gelatin added. The results are probably best explained on the assumption that there is a chemical action between the gelatin and sulfuric acid in which a single compound is formed. In this compound the hydrogen of the acid loses its identity and when the compound dissociates there is formed a complex gelatin hydrogen positive ion and a negative sulfate ion.

The entropy of monatomic gases: GILBERT N. LEWIS.

The electrometric titration of uranium with potassium dichromate and potassium permanganate: D. T. EWING and E. F. ELDRIDGE.

The heat of coagulation of ferric oxide hydrosol by electrolytes: FREDERICK L. BROWN and J. H. MATHEWS.

Some quantitative experiments on coagulation of colloids: RAY V. MURPHY and J. H. MATHEWS. The lowest concentration (limiting concentration) of electrolytes necessary to coagulate hydrous ferric oxide sol has been studied as a function of the purity of the sol (ratio of gram-equivalents of Fe to gram-equivalents of Cl) and of the concentration of Fe_2O_3. Chloride, chromate and ferricyanide ions were used in the form of the potassium salts. The conclusions drawn are: (1) The limiting concentration decreases with increasing purity in the case of all three ions, the mechanism of the process being evidently similar for the three ions; (2) The limiting concentration decreases markedly with decreasing concentration of the sol in the case of all three ions, but the relation indicated by Burton and Bishop, *Jour. Phys. Chem.*, 24, 701 (1920), for mastic, As_2S_3 and Cu sols, holds for Fe_2O_3 hydrosol only in the case of the trivalent ion.

The alkalinity of Searles Lake brine: ROGER C. WELLS. The title may mean either the titration alkalinity or the hydrogen ion concentrations. The latter may be considered as determined by certain proportions of the four buffer substances Na_2CO_3, $NaHCO_3$, $Na_2B_4O_7$, and $Na_2B_2O_4$. The writer has found for the brine $P_H = 9.48$. By determining the P_H values of artificial brines containing each pair of buffers separately it is possible to draw curves from which by interpolation the proper proportions of the buffers to yield $P_H = 9.48$ may be read. This method serves as a check of the analyti-

cal determinations and yields a logical conventional form for expressing the whole analysis of the brine.

The vapor density of technical phosgene: A. F. O. Germann and Vernon Jersey. A 75 gm. sample of technical phosgene was distilled from a large cylinder of the liquefied gas, obtained from the Chemical Warfare Service through Dr. Goss. Pure phosgene has a vapor tension at 0° C. of about 552 mm.; the sample taken showed a vapor tension in excess of one atmosphere at — 80° C., that is, in a bath of solid carbon dioxide and acetone. The sample was subjected to fractional distillation in a vacuum until the vapor tension at 0° C. was approximately correct. Following this, three fractional distillations alternated with three determinations of the vapor density of the gas, until five groups of three determinations each had been obtained for the vapor density, and the nearly pure gas had been fractionally distilled 15 times.

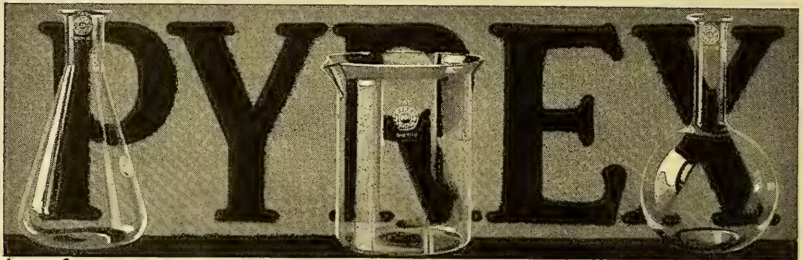
Average of 1st group of densities	4.4708
" " 2d " " "	4.5060
" " 3d " " "	4.5216
" " 4th " " "	4.5244
" " 5th " " "	4.5263

The values given are in grams per liter at standard conditions, uncorrected for the compressibility of the gas and for the contraction of the globes when evacuated. Technical phosgene is very impure. The principal impurities are very volatile and of relatively low molecular weight, probably carbon dioxide and hydrogen chloride resulting from hydrolysis. Repeated fractional distillation yields a product whose density tends toward a maximum value, probably the value for pure phosgene.

The cryoscopy of boron trifluoride solutions: V. Systems with methyl ether and with methyl chloride: A. F. O. Germann and Marion Cleaveland. Gasselin prepared the compound $BF_3.(CH_3)_2O$ by mixing the gases; he obtained a liquid boiling at 126° C. This compound has been prepared from liquid boron trifluoride and liquid methyl ether in the course of the determination of the melting point curve of solutions of the two substances. The curve shows a eutectic at 3 per cent. BF_3 (molecular percentages) and a maximum at 50 per cent. The vapor tensions of solutions containing from 60 per cent. to 90 per cent. BF_3 were so high, that the form of apparatus used was inadequate. The form of the curve so far as determined seems to indicate the existence of a second compound in this interval. Methyl chloride was prepared from salt, sulfuric acid and wood alcohol; was purified by repeated fractional distillations; and gave the usual indications of a pure substance, such as constant freezing point for the first and last fractions of the liquid. The melting point curve with BF_3 shows two maxima, at 15 per cent. BF_3, and at 33 per cent. BF_3, and an angular point in the curve at 50 per cent. The form of the maxima at 15 per cent. is identical with that at 50 per cent. for methyl ether; the mixture yields about 15 per cent. of the total volume of a liquid, whose freezing and boiling points are identical with those of $BF_3.(CH_3)_2O$. The logical inference is that methyl chloride as prepared contains methyl ether as an impurity, and that this impurity yields a constant boiling mixture. It would seem that boron trifluoride might be used as a test for the presence of methyl ether in methyl chloride; the same test might be extended to the homologues. The interpretation of the other maxima mentioned must await the completion of further work on the purity of methyl chloride.

The cryoscopy of phosgene solutions: I. System with chlorine: A. F. O. Germann and V. Jersey. The melting point curve of solutions of phosgene and chlorine was determined. The curve is very complex. There is a eutectic at 25 per cent. (molecular percentages) chlorine; and angular points in the curve at 6 per cent., 11 per cent., 50 per cent., 63 per cent., 75 per cent. and 91 per cent. chlorine. The following compounds, which dissociate at the melting point, are indicated: $16COCl_2.Cl_2$; $8COCl_2.Cl_2$; $COCl_2.Cl_2$; $3COCl_2.5Cl_2$; $COCl_2.3Cl_2$; and $COCl_2.10Cl_2$. The second of these, chlorine octaphosgenate, is particularly interesting, as corresponding with the octahydrate of chlorine. The affinity of chlorine for phosgene, and the instability of the compounds would seem to offer an explanation of the mechanism of certain phases of the catalysis of carbon monoxide and chlorine by means of charcoal saturated with chlorine. If we assume a layer of chlorine molecules on the surface of the charcoal, the high concentration of chlorine thus obtained might be supposed in the presence of carbon monoxide to shift the equilibrium in the direction of one of the chlorine-phosgene complexes, which promptly decomposes because of its instability, leaving the surface film of chlorine for further action. It would be desirable to determine the melting point curve of carbon monoxide and chlorine solutions, to clear up some of the points involved in this reaction.

Charles L. Parsons,
Secretary



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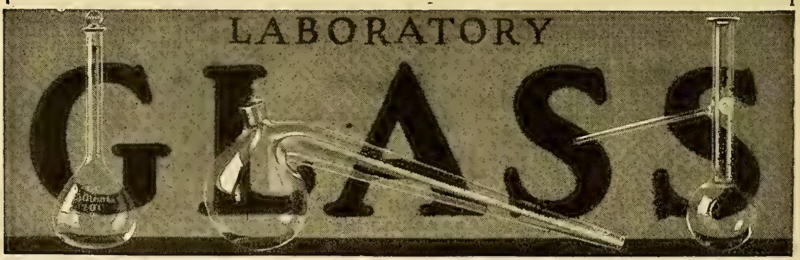

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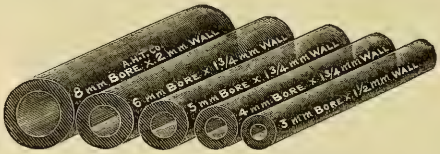

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Thickness of wall, mm.	1½	1¾	1¾	1¾	2
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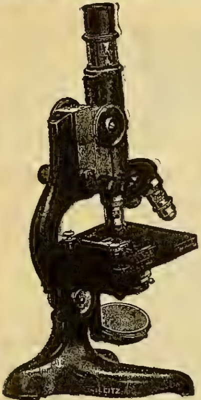

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